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## BOOK ONE

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# MATHEMATICS
## FOR
# EVERYDAY USE

BY
LILIAN BANTING
A. D. BANTING
AND
LEO J. BRUECKNER

## BOOK ONE

AUTHORIZED BY THE MINISTERS OF EDUCATION
IN ALBERTA AND MANITOBA

THE JOHN C. WINSTON CO., LIMITED
TORONTO

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# INTRODUCTION

This book contains an enriched and vitalized treatment of mathematics for Grade Seven.

The simple, well-integrated treatment of arithmetic and geometry which this text affords, contributes effectively to the development in the pupils of an appreciation of the function of number as a tool for thinking, or a method of thinking. The mathematics presented is that of the community and of the daily life of the pupil. This rich socialized material insures sustained interest.

The provision that has been made for individual differences is one of the outstanding features of this series. The following specific points may be listed:

*1.* Survey tests for each process to enable the teacher, at the beginning of the year, to get a general picture of the ability of the pupils in the various fundamental arithmetic processes.

*2.* Comprehensive diagnostic tests in the various processes to enable the teacher to locate specific weaknesses in the process. These tests are similar to the well-known Brueckner Diagnostic Tests in the several processes.

*3.* In a very skilful way these comprehensive diagnostic tests are woven into an effective remedial and practice programme.

*4.* Special pupil helps on difficult points in the various processes are provided for pupil reference. This plan insures the possibility of the pupil himself working directly on the problem of eliminating his difficulties with a minimum of attention from the teacher.

*5.* In order to insure maintenance of the acquired skills throughout the year, periodic standardized practice tests are provided. The standards for these drills are reasonable speed and 100-per-cent accuracy. The time limits are liberal and



123320

include time needed for checking all work. A premium is placed on accurate work.

*6.* Problem scales and helps in problem solving enable the teacher to locate pupils deficient in problem solving and contain the basis of a sound remedial program in problem solving.

*7.* Starred problems, topics for special reports, suggested investigations, and many devices for maintaining a sustained interest on the part of pupils of superior ability are a distinct contribution to the pedagogy of mathematics. These materials may be used at the option of the teacher who will assign the work according to the abilities and interests of the class.

*8.* The carefully graded steps in teaching and the wealth of practice exercises tend to insure mastery.

*9.* Systematic review exercises at the close of each chapter give accurate information to the teacher and to the pupils as to the progress made.

Teachers should adjust the amount of work covered by a class to the ability of the class. There is enough material provided for the superior class. Starred problems, and in some cases whole sets of problems, may be omitted in the case of slow classes without interfering with the major sequence of the book. It is not expected that every class will cover the entire body of material.

**ACKNOWLEDGMENTS**

Grateful acknowledgment is made to the following organizations who courteously permitted the use of the illustrative material in this book.

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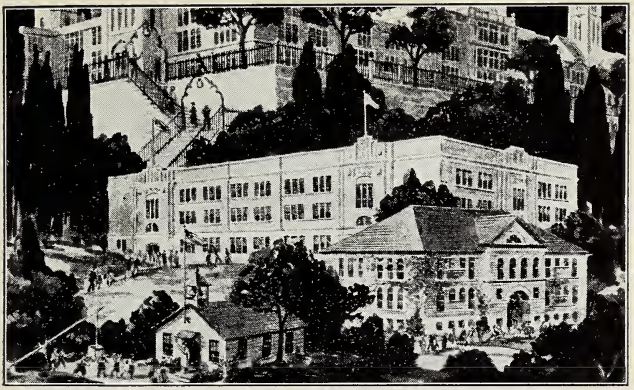
THE HOUSE OF PARLIAMENT AT OTTAWA

**The design of this beautiful building contains many different geometric figures about which you will study this year.**



# SECTION I

## THE COST OF AN EDUCATION

Have you ever thought about how much money your parents and the taxpayers are spending for your education? The table below contains certain information about the annual costs from the elementary school through the University, not including the ordinary cost of living.

| Level of Education | Cost a Year |
|---|---|
| Elementary | $65 |
| Secondary | 130 |
| University | 520 |

**1.** According to the above table at which level is the annual cost of education lowest? At which level is the cost highest?

**2.** How many times as much as the annual cost of education in the elementary schools is the annual cost in secondary schools? in the University?

**3.** How many times as much as the annual cost of education in the secondary schools is the University cost?

**4.** Find the cost of 8 years of elementary education for one pupil; for a class of 35 puplis.

**5.** Find the cost of 3 years of secondary education for one pupil; for the number of pupils in your class.

**6.** Find the total cost of eight years of elementary, 3 years of secondary, and 4 years of University education for one persen, using the rates given in the table.

**7.** In a recent year the costs of rearing the average Canadian child for a period of 18 years were as follows:

| | |
|---|---|
| Food | $1,550 |
| Clothing | 800 |
| Housing and related costs | 2,050 |
| Health, recreational and social costs | 600 |

Find the total cost.

**8.** Assuming the average cost of the total education of each Canadian child to be $750, find the total cost of rearing a child for a period of 18 years, including the cost of education.

**9.** Find the total cost for a year to the nearest dollar.

**10.** In 1913 the expenditure on publicly-controlled elementary and secondary schools was $54,000,000; in 1931 it was $140,000,000. Find the increase.

**11.** In 1913 the enrollment was 1,438,000; in 1931 the enrollment was 2,214,000. Find the increase.

***12.** What is the total annual cost of education for a pupil in your school? Find out how the money to pay for the schools is raised. Make a table showing the enrollment per grade in your school. Use either local rates or the rates in the table on page 1 to find the total cost of educating the pupils in your school.

## MEASURING YOUR ABILITY IN ARITHMETIC

Did you make any errors in computation in solving the problems on pages 1 and 2?

In order to be efficient in your work in mathematics, you must know how to compute quickly and accurately.

The first thing to do is to test yourself to find out whether you can work examples in arithmetic as well as pupils in your grade should be able to work them.

If tests show that your work is not satisfactory, you should practise exercises in the processes in which your scores are below standard. All pupils will not need the same kind of practice, nor will all need to work on the same process.

On page 4 are tests in the four fundamental processes in whole numbers. Within the time allowed, you should be able to work correctly and check all the examples in each test.

To save time and to avoid errors due to copying numbers incorrectly, write the answers for the addition and subtraction tests on folded paper placed directly below the examples.

Copy the examples in the multiplication and division tests before counting time. Allow plenty of space for your work.

Check each step of your work in each example. This will prevent many errors due to carelessness.

If your work in whole numbers is satisfactory, you may take the tests on fractions (page 16) to see if you need special practice in any process. If you cannot work correctly all the examples in each test within the time allowed, you need more practice.

## SURVEY TESTS IN THE FUNDAMENTALS

### ADDITION (6 minutes, not including copying)

| 1. | 2. | 3. | 4. | 5. | 6. |
|---|---|---|---|---|---|
| 823 | 968 | 724 | 570 | 673 | 702 |
| 486 | 867 | 907 | 895 | 659 | 245 |
| 957 | 378 | 719 | 917 | 262 | 741 |
| 421 | 595 | 728 | 568 | 153 | 243 |
| 738 | 482 | 341 | 473 | 706 | 755 |
| 529 | 399 | 963 | 526 | 541 | 166 |
| 445 | 880 | 607 | 650 | 484 | 647 |

### SUBTRACTION (4 minutes, not including copying)

| 1. | 2. | 3. | 4. |
|---|---|---|---|
| 6,080 | 4,001 | 4,900 | 5,811 |
| 5,769 | 1,873 | 2,664 | 2,006 |
| **5.** | **6.** | **7.** | **8.** |
| 8,034 | 4,462 | 3,936 | $10.51 |
| 5,708 | 3,838 | 2,978 | 9.52 |
| **9.** | **10.** | **11.** | **12.** |
| 16,767 | 12,157 | 9,000 | 9,995 |
| 6,788 | 6,148 | 7,142 | 8,997 |

### MULTIPLICATION (8 minutes, not including copying)

| 1. | 2. | 3. | 4. | 5. | 6. |
|---|---|---|---|---|---|
| 369 | 485 | 673 | 739 | 478 | 854 |
| 74 | 59 | 28 | 96 | 37 | 69 |
| **7.** | **8.** | **9.** | **10.** | **11.** | **12.** |
| 271 | 506 | 958 | 250 | 289 | 369 |
| 504 | 360 | 800 | 709 | 326 | 915 |

### DIVISION (8 minutes, not including copying)

**1.** $65\overline{)13{,}520}$ **2.** $41\overline{)8{,}405}$ **3.** $46\overline{)5{,}008}$ **4.** $29\overline{)89{,}030}$

**5.** $85\overline{)9{,}240}$ **6.** $53\overline{)42{,}718}$ **7.** $73\overline{)75{,}920}$ **8.** $84\overline{)21{,}000}$

Use examples on pages 6, 8, 10, and 12 for practice in the processes in which your work is not up to standard.

## RECORDING AND GRAPHING PRACTICE TEST SCORES

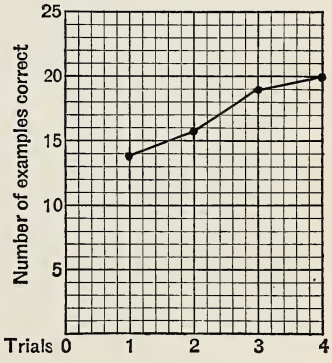
If you keep a record of your scores on the practice exercises, you will be able to see how your work is improving. A good form to use for keeping this record in your notebook is shown below. A progress chart is also given.

RECORD OF PRACTICE TEST SCORES—*Jack Brown*

| EXERCISE | TRIAL | DATE | NUMBER TRIED | NUMBER CORRECT |
|---|---|---|---|---|
| Addition I..... | 1 | 9/10 | 18 | 14 |
| Addition I..... | 2 | 9/11 | 19 | 16 |
| Addition I..... | 3 | 9/12 | 20 | 19 |
| Addition I..... | 4 | 9/13 | 20 | 20 |

Make a copy of the form in your notebook. In place of Jack Brown's record on his four trials of Addition, Set I, enter your *practice test* scores.

Miss Stark showed the pupils how to make graphs of their progress on the practice exercises. Here is Harold's progress chart.




The graph is made on *cross-section paper*.

The heavy black dot above Trial 1 on the horizontal line opposite 14 shows that on that trial Harold had 14 examples correct. How many did he have correct on his second trial? on each of his other trials?

Graphs like the one Miss Stark drew are called *line* graphs. Why is this a good name?

## GRADED PRACTICE EXERCISES IN ADDITION

If your scores on the tests on page 4 were not satisfactory, practise the sets (pp. 6, 8, 10, 12, 13) in the process which you found difficult. Check your work. Practise until you can complete each set in the time allowed.

### Set I (2 minutes)

| 1. | 3. | 5. | 7. | 9. | 11. | 13. | 15. | 17. | 19. |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 9 | 9 | 7 | 8 | 8 | 7 | 9 | 9 | 7 |
| 5 | 3 | 7 | 2 | 5 | 4 | 2 | 3 | 2 | 2 |
| 2 | 4 | 2 | 5 | 3 | 5 | 4 | 3 | 6 | 7 |

| 2. | 4. | 6. | 8. | 10. | 12. | 14. | 16. | 18. | 20. |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 7 | 7 | 7 | 7 | 6 | 9 | 9 | 9 | 9 |
| 3 | 4 | 4 | 6 | 5 | 6 | 5 | 8 | 3 | 7 |
| 8 | 9 | 6 | 5 | 9 | 6 | 5 | 3 | 9 | 8 |

### Set II (2 minutes)

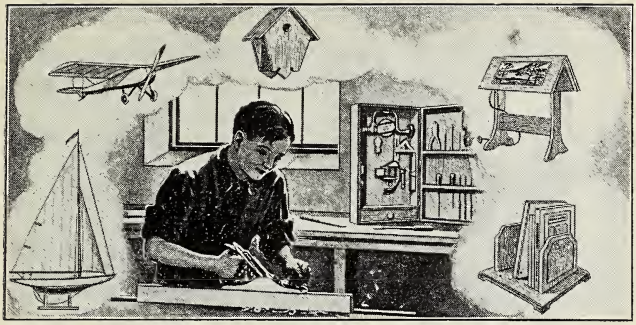
| 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 5 | 8 | 8 | 2 | 7 | 8 | 5 | 1 | 3 |
| 2 | 6 | 4 | 9 | 7 | 3 | 5 | 8 | 4 | 9 |
| 6 | 6 | 4 | 5 | 3 | 1 | 9 | 4 | 3 | 8 |
| 8 | 4 | 3 | 8 | 8 | 5 | 2 | 4 | 9 | 7 |
| 4 | 2 | 6 | 3 | 6 | 1 | 6 | 9 | 5 | 9 |
| 1 | 8 | 9 | 7 | 8 | 9 | 7 | 4 | 7 | 7 |

### Set III (4 minutes)

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. |
|---|---|---|---|---|---|---|---|
| 47 | 96 | 53 | 41 | 24 | 34 | 70 | 90 |
| 71 | 52 | 78 | 37 | 97 | 43 | 20 | 95 |
| 62 | 87 | 78 | 68 | 26 | 35 | 93 | 84 |
| 76 | 56 | 63 | 49 | 52 | 93 | 86 | 92 |
| 97 | 69 | 84 | 55 | 72 | 46 | 31 | 82 |
| 89 | 81 | 49 | 68 | 59 | 92 | 11 | 86 |
| 19 | 57 | 86 | 99 | 37 | 89 | 18 | 79 |

### Set IV (4 minutes)

1. $3{,}986 + 4{,}753 + 5{,}967 + 4{,}798 + 5{,}964 =$
2. $487 + 790 + 564 + 856 + 73 + 9{,}846 =$
3. $96 + 8{,}754 + 768 + 59 + 78{,}974 =$



**BUYING A CHEST OF TOOLS**

John, who is taking a shop course, wishes to buy a tool chest, the price of which is $6.59. In a catalogue he finds the prices of the various tools as follows:

| | | | |
|---|---|---|---|
| Saw | $1.20 | Square | $.51 |
| Hammer | .65 | Awl | .37 |
| Screw driver | .24 | Level | .68 |
| Pliers | .36 | Plane | 1.22 |
| 1 lb. assorted nails | .18 | Chalk line | .10 |
| Wrench | .65 | Chest | 1.85 |

**1.** Find the total cost of the tools and the chest, if bought one at a time.

**2.** Allowing $1.85 as the cost of the chest, find the cost of the tools only when bought in a set. How much less is this than the cost of all the tools in the set at catalogue prices?

**3.** Which would be cheaper for John to buy, the set at the sale price or the tools he needed and the chest at the prices listed in the catalogue? John already has a hammer.

**4.** Why are things usually cheaper when sold in sets than when sold one piece at a time?

## PRACTICE EXERCISES IN SUBTRACTION

Keep a record of your scores on repeated trials of each set.

**Set I (5 minutes)**

| | *a* | *b* | *c* | *d* | *e* |
|---|---|---|---|---|---|
| **1.** | 49 | 414 | 689 | 46 | 897 |
| | 5 | 7 | 3 | 21 | 346 |
| **2.** | 89 | 29 | 852 | 90 | 806 |
| | 89 | 9 | 101 | 60 | 203 |
| **3.** | 79 | 567 | 796 | 774 | 832 |
| | 77 | 563 | 22 | 414 | 532 |
| **4.** | 73 | 494 | 578 | 925 | 912 |
| | 8 | 49 | 349 | 654 | 765 |
| **5.** | 6,172 | 524 | 140 | 809 | 602 |
| | 2,753 | 195 | 3 | 228 | 516 |

**Set II (5 minutes)**

| | | | | | |
|---|---|---|---|---|---|
| **1.** | 4,001 | 9,400 | 604 | 8,511 | 8,034 |
| | 2,873 | 3,664 | 106 | 2,006 | 7,508 |
| **2.** | 8,060 | 9,010 | 11,900 | 4,462 | 3,396 |
| | 6,759 | 3,581 | 8,904 | 3,388 | 2,988 |
| **3.** | 16,767 | 17,466 | 12,157 | $.09 | $.11 |
| | 6,798 | 6,779 | 7,149 | .04 | .04 |
| **4.** | $1.10 | $1.30 | $125.31 | $10.41 | $10.00 |
| | .80 | .10 | 41.95 | 9.42 | .06 |

So Round So Firm So fully packed ???



## USING ROUND NUMBERS

**1.** A newspaper article stated that in 1931 there were 10,000,000 people in Canada. Do you think that this was the exact number of inhabitants? Why do newspapers often use approximate numbers?

**2.** Records show that the area of Canada is 3,684,723 square miles. Would it be permissible to say that the area is 3,684,000 square miles? that the area is 3,680,000 square miles? Why?

When exact information is not required, very large numbers are expressed to the nearest thousand, ten thousand, or larger group, depending upon the size of the numbers. When one expresses numbers in this way, one is said to be using *round numbers*. For example, 3,684,723 may be written in round numbers as 3,685,000, correct to the nearest thousand, or as 3,700,000, correct to the nearest hundred thousand.

Write the following, correct to the nearest thousand; to the nearest ten thousand; to the nearest hundred thousand.

**3.** 23,416,302 bbl.
**4.** 1,924,590 bbl.
**5.** 487,737,740 T.
**6.** $1,752,860
**7.** 6,754,964,270 bu.
**8.** $1,875,964.90
**9.** 3,045,006 lb.
**10.** 8,000,765 gal.

**11.** The areas of six sections of Canada are given in square miles in the table below:

| | | | |
|---|---|---|---|
| Alberta | 255,285 | Northwest Territories | 1,309,682 |
| British Columbia | 355,900 | Ontario | 407,262 |
| Manitoba | 251,832 | Quebec | 594,434 |

Give the above numbers correct to the nearest hundred; to the nearest thousand; to the nearest ten thousand.

## PRACTICE EXERCISES IN MULTIPLICATION

### Set I (5 minutes)

| | *a* | *b* | *c* | *d* | *e* |
|---|---|---|---|---|---|
| 1. | 8 | 32 | 20 | 51 | 912 |
| | 7 | 3 | 4 | 3 | 4 |
| 2. | 430 | 700 | 601 | 2,010 | 507 |
| | 2 | 5 | 3 | 6 | 7 |
| 3. | 3,060 | 98 | 516 | 581 | 578 |
| | 9 | 5 | 6 | 8 | 9 |

### Set II (5 minutes, not including copying)

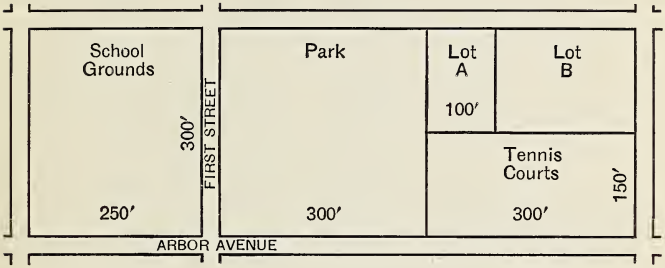
| | | | | | |
|---|---|---|---|---|---|
| 1. | 12 | 432 | 430 | 612 | 312 |
| | 21 | 21 | 43 | 50 | 700 |
| 2. | 432 | 4,002 | 78 | 54 | 369 |
| | 805 | 69 | 63 | 75 | 78 |
| 3. | 849 | 709 | 9,008 | 6,070 | 628 |
| | 490 | 796 | 123 | 824 | 705 |

### Set III (5 minutes, not including copying)

| | | | | | |
|---|---|---|---|---|---|
| 1. | $.02 | $.06 | $3.20 | $16.40 | $.10 |
| | 4 | 9 | 5 | 80 | 90 |
| 2. | $.05 | $30.60 | $46.00 | 7,865 | 7,859 |
| | 14 | 265 | 46 | 2,300 | 958 |
| 3. | 7,006 | 9,070 | 8,053 | 2,597 | 4,005 |
| | 1,004 | 3,069 | 4,609 | 8,000 | 7,000 |

## MEASURING AREAS

This is a map of part of the two blocks near which Harry lives.




**1.** How long is the block in which the park is located? How wide is it?

**2.** What is the distance around the park?

**3.** What is the distance around the school grounds?

**4.** What is the area of the school grounds?

**5.** How much larger than the school grounds is the park?

**6.** What is the area of the block in which the park is located?

**7.** What are the dimensions of lot *A*? lot *B*?

**8.** Which has the larger area, lot *A* or lot *B*? how much larger?

**9.** Lot *B* sold for $1,500. How much was this a square foot?

**10.** Are the school grounds more or less than an acre in area, and how much? (An acre = 43,560 square feet.)

***11.** What is the area of your school grounds?

***12.** What is the area of the piece of land on which your house is built?

## GRADED PRACTICE EXERCISES IN DIVISION

Write the quotients only.

Set I (2 minutes)

| | *a* | *b* | *c* | *d* | *e* | *f* |
|---|---|---|---|---|---|---|
| 1. | 20)60 | 21)63 | 23)46 | 41)84 | 32)96 | 12)48 |
| 2. | 30)93 | 21)47 | 32)68 | 43)99 | 22)59 | 23)58 |
| 3. | 82)246 | 41)205 | 92)184 | 43)129 | 51)308 | 83)249 |
| 4. | 62)289 | 81)578 | 74)199 | 82)399 | 32)139 | 41)298 |

Set II (4 minutes)

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | 34)74 | 91)850 | 63)150 | 41)172 | 57)180 | 87)625 |
| 2. | 32)290 | 87)610 | 53)480 | 77)625 | 48)150 | 43)270 |
| 3. | 55)213 | 33)272 | 43)202 | 26)161 | 69)483 | 58)406 |
| 4. | 38)152 | 53)401 | 14)70 | 96)380 | 13)112 | 15)90 |

Work the following examples carefully.

Set III (9 minutes)

| | *a* | *b* | *c* | *d* | *e* |
|---|---|---|---|---|---|
| 1. | 31)671 | 21)483 | 16)176 | 32)672 | 23)483 |
| 2. | 52)1,768 | 71)2,698 | 90)7,920 | 71)2,589 | 40)3,440 |
| 3. | 14)294 | 51)2,499 | 94)1,400 | 42)2,226 | 53)2,332 |

Set IV (9 minutes)

| | *a* | *b* | *c* | *d* | *e* |
|---|---|---|---|---|---|
| **1.** | 31)930 | 81)1,655 | 81)7,290 | 62)1,875 | 12)248 |
| **2.** | 82)4,100 | 93)3,724 | 53)3,720 | 71)2,140 | 12)370 |
| **3** | 91)6,390 | 72)4,350 | 64)4,736 | 74)4,884 | 52)2,236 |

Set V (9 minutes)

| | | | | | |
|---|---|---|---|---|---|
| **1.** | 77)4,928 | 39)3,145 | 56)2,598 | 25)1,500 | 75)6,308 |
| **2.** | 17)1,394 | 54)3,599 | 33)1,597 | 91)9,022 | 61)4,819 |
| **3.** | 16)757 | 14)1,367 | 15)1,395 | 93)3,906 | 42)3,990 |

Set VI (10 minutes)

| | | | | | |
|---|---|---|---|---|---|
| **1.** | 34)7,174 | 57)6,099 | 49)14,398 | 18)15,200 | 57)16,099 |
| **2.** | 12)11,772 | 27)4,185 | 32)30,848 | 74)28,658 | 63)18,119 |
| **3.** | 16)11,968 | 37)9,546 | 46)32,614 | 85)62,900 | 77)63,187 |

Set VII (10 minutes)

| | *a* | *b* | *c* | *d* |
|---|---|---|---|---|
| **1.** | 184)36,432 | 648)34,992 | 567)92,370 | 327)94,360 |

| | *a* | *b* | *c* |
|---|---|---|---|
| **2.** | \$4.68)\$987.58 | \$9.34)\$752.17 | \$2.24)\$275.06 |
| **3.** | \$1.31)\$82.43 | \$7.12)\$733.36 | \$.98)\$697.76 |

## HOW TO SOLVE PROBLEMS

You will find that answering the following four questions about every problem you are asked to solve will help you to solve problems correctly:

**I.** *What does the problem ask for?* Be sure that you understand every word in the problem.

**II.** *What must be done to solve the problem if all the facts are not clear?* Decide what you must do to get the answer to the problem. Often there is more than one step in the work. Be sure that you have all facts needed to solve the problem.

**III.** *What is a reasonable answer?* Estimate the answer before you perform the necessary computations. This will prevent many foolish mistakes. Compare your final answer with your estimate.

**IV.** *What checks should be used?* About 30% of all failures to solve problems correctly are due to errors in computation. It is important, therefore, to check all your work.

**Answer questions I to IV for the following problems:**

**1.** In one year John's height increased from $49\frac{1}{2}$ inches to $51\frac{1}{4}$ inches. What was his average monthly increase in height?

**2.** On a 150-mile automobile trip, Mr. Jones used $7\frac{1}{2}$ gallons of gasoline at 20 cents a gallon. How much was the average cost of gasoline a mile?

**3.** Henry bought a bicycle, regularly priced at $24, at a "$\frac{1}{4}$-off" sale. How much did he pay for the bicycle?

**4.** Helen bought $4\frac{1}{2}$ yards of cloth for 30 cents a yard. How much change should she receive from a $5 bill?

**5.** Harry can run 440 yards in 1 minute and 10 seconds. How long would it take him to run a mile at the same rate?

**6.** Mr. Smith has a garden 60 feet long and 40 feet wide. How much would it cost to build a fence around the garden at 15 cents a running foot, making no allowance for openings?

**7.** A carpenter wished to cut a board 8 feet 6 inches long into six pieces of equal length. How long must each piece be?

**8.** Henry paid $6\frac{1}{2}$ cents each for Sunday magazines and sold them for 10 cents each. How much did he gain if he sold 100 magazines?

**9.** Frank's school is giving a picnic. The picnic committee decided to buy one quart of ice cream for each 6 children. If 180 children attended the picnic, how much did the ice cream cost at 50 cents a quart?

**10.** Jack has a garden in which he grows raspberries. One day he picked 30 boxes of berries in the morning and 24 boxes in the afternoon. He sold them all at 2 boxes for 25 cents. How much did he receive for the raspberries?

**11.** Alice bought $4\frac{1}{4}$ yards of cloth for a dress. The cloth cost 60 cents a yard. How much change should she receive from a five-dollar bill?

**12.** Helen sold 11 bouquets of sweet peas at 25 cents each, 15 bouquets of mixed flowers at 20 cents each, and 18 dozen ears of corn at 15 cents a dozen. How much did she receive for all she sold?

## SURVEY TESTS IN FRACTIONS

If you make any mistakes in these tests, practise the exercises on pages 19 to 30, which contain examples in the processes in which your work was incorrect.

### ADDITION OF FRACTIONS (5 minutes, not including copying)

**1.** $\frac{7}{8}$ / $\frac{7}{8}$

**2.** $3\frac{4}{5}$ / $6\frac{2}{5}$

**3.** $8\frac{5}{6}$ / $4\frac{5}{6}$

**4.** $\frac{1}{2}$ / $\frac{1}{8}$ / $\frac{1}{8}$

**5.** $\frac{2}{3}$ / $\frac{1}{6}$ / $\frac{1}{2}$

**6.** $\frac{5}{6}$ / $\frac{2}{3}$

**7.** $\frac{1}{8}$ / $\frac{1}{6}$ / $\frac{1}{4}$

**8.** $2\frac{3}{4}$ / $21\frac{1}{2}$

**9.** $7\frac{2}{3}$ / $8\frac{3}{4}$

**10.** $6\frac{1}{2}$ / $2\frac{1}{2}$ / $4\frac{1}{4}$

**11.** $\frac{5}{6}$ / $4\frac{3}{4}$ / $\frac{2}{3}$

**12.** $6\frac{4}{5}$ / $\frac{1}{4}$ / $\frac{1}{4}$

### SUBTRACTION OF FRACTIONS (5 minutes, not including copying)

**1.** $\frac{1}{4}$ / $\frac{1}{4}$

**2.** $\frac{1}{2}$ / $\frac{1}{6}$

**3.** $1$ / $\frac{1}{3}$

**4.** $23\frac{3}{4}$ / $11\frac{1}{2}$

**5.** $7\frac{3}{4}$ / $\frac{1}{4}$

**6.** $6\frac{1}{4}$ / $6\frac{1}{6}$

**7.** $9$ / $\frac{2}{5}$

**8.** $26\frac{1}{4}$ / $17\frac{2}{3}$

**9.** $7\frac{1}{8}$ / $\frac{3}{8}$

**10.** $21\frac{1}{5}$ / $18\frac{3}{4}$

**11.** $6\frac{1}{3}$ / $3$

**12.** $12\frac{1}{8}$ / $12\frac{1}{8}$

### MULTIPLICATION OF FRACTIONS (5 minutes, not including copying)

**1.** $\frac{5}{6} \times 14 =$

**2.** $6 \times \frac{1}{4} =$

**3.** $2 \times 4\frac{1}{5} =$

**4.** $3\frac{1}{8} \times 6 =$

**5.** $\frac{2}{5} \times 3\frac{2}{3} =$

**6.** $6\frac{4}{5} \times \frac{3}{7} =$

**7.** $3\frac{3}{4} \times 3\frac{1}{3} =$

**8.** $\frac{5}{8} \times \frac{16}{25} \times \frac{1}{2} =$

**9.** $\frac{3}{8} \times \frac{10}{21} =$

**10.** $18 \times 15\frac{3}{4} =$

**11.** $4\frac{3}{8} \times 2\frac{6}{7} \times 1\frac{4}{5} =$

**12.** $4\frac{2}{3} \times 6\frac{1}{7} =$

### DIVISION OF FRACTIONS (5 minutes, not including copying)

**1.** $12 \div \frac{3}{4} =$

**2.** $1\frac{3}{5} \div \frac{1}{2} =$

**3.** $2\frac{5}{8} \div \frac{3}{4} =$

**4.** $\frac{6}{11} \div 3 =$

**5.** $5\frac{3}{5} \div 2 =$

**6.** $1\frac{1}{5} \div 4 =$

**7.** $\frac{3}{8} \div 1\frac{2}{3} =$

**8.** $5 \div 2\frac{1}{2} =$

**9.** $1\frac{1}{5} \div 3\frac{1}{2} =$

**10.** $3\frac{3}{8} \div 1\frac{1}{4} =$

**11.** $\frac{7}{9} \div \frac{5}{6} =$

**12.** $7\frac{1}{4} \div 3\frac{2}{3} =$

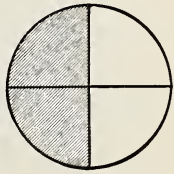
## IMPORTANT POINTS ABOUT FRACTIONS

Before you begin to practise on the processes in fractions in which your test scores were unsatisfactory, answer all the questions below, and then practise the processes in which you had errors on the test.

**1.** What must be done with unlike fractions before they can be added or subtracted?

**2.** In what form should the terms of a fraction be expressed in the answer?

**3.** On the figure at the right notice that $\frac{2}{4}$ equals $\frac{1}{2}$. Draw a similar figure showing that $\frac{4}{8}$ equals $\frac{2}{4}$.



**4.** To reduce fractions to lowest terms, divide each term by a *common factor*. A common factor is a number by which both terms can be divided.

$$\frac{12 \div 2 = 6}{18 \div 2 = 9} \qquad \frac{6 \div 3 = 2}{9 \div 3 = 3} \qquad \frac{12}{18} = \frac{6}{9} = \frac{2}{3}$$

By what common factor was $\frac{12}{18}$ divided? $\frac{6}{9}$?

**5.** Reduce the following fractions to lowest terms:

*a.* $\frac{12}{16}$; *b.* $\frac{15}{20}$; *c.* $\frac{8}{20}$; *d.* $\frac{8}{12}$; *e.* $\frac{16}{24}$; *f.* $\frac{75}{100}$; *g.* $\frac{125}{1,000}$.

**6.** Sometimes the answer contains an improper fraction, as $\frac{11}{4}$, or $4\frac{6}{3}$. To change $\frac{11}{4}$ to a mixed number, divide 11 by 4. $\frac{11}{4} = 11 \div 4 = 2\frac{3}{4}$.

To change $4\frac{6}{3}$ to simplest form, first reduce $\frac{6}{3}$ to 2. $4\frac{6}{3}$ is equal to 4 and 2, or 6.

Reduce the following to simplest form:

*a.* $\frac{12}{8}$; *b.* $\frac{14}{6}$; *c.* $\frac{16}{7}$; *d.* $\frac{18}{9}$; *e.* $\frac{6}{3}$; *f.* $4\frac{6}{4}$; *g.* $5\frac{3}{2}$; *h.* $8\frac{7}{5}$; *i.* $9\frac{8}{4}$; *j.* $6\frac{2}{2}$.

**7.** In adding and subtracting unlike fractions, change them to fractions having the same denominator. In

working the example, $\frac{1}{2} - \frac{1}{4}$, express both fractions in fourths.

Use a figure like the circle on page 17 to show that $\frac{1}{2}$ equals $\frac{2}{4}$.

Show by a similar figure that $\frac{1}{2}$ equals $\frac{4}{8}$.

**8.** You can change $\frac{1}{2}$ to fourths by multiplying both terms of the fraction by 2. How can you change $\frac{1}{2}$ to eighths?

$$\frac{1 \times 2}{2 \times 2} = \frac{2}{4}$$

**9.** Change the following fractions to twelfths; to twenty-fourths:

*a.* $\frac{1}{2}$; *b.* $\frac{1}{4}$; *c.* $\frac{3}{4}$; *d.* $\frac{2}{3}$; *e.* $\frac{1}{3}$; *f.* $\frac{1}{6}$; *g.* $\frac{5}{6}$.

**10.** How can you change $1\frac{1}{4}$ to an improper fraction?

**11.** How many halves are there in 4?

**12.** Change $1\frac{1}{2}$ to halves, thus changing $1\frac{1}{2}$ to an improper fraction.

**13.** Change the following to improper fractions:

*a.* $1\frac{1}{3}$; *b.* $1\frac{3}{4}$; *c.* $2\frac{1}{2}$; *d.* $3\frac{1}{3}$; *e.* $3\frac{1}{2}$; *f.* $4\frac{1}{4}$; *g.* $6\frac{3}{4}$.

**14.** *a.* Show that 5 equals $4\frac{2}{2}$; *b.* show that 6 equals $5\frac{4}{4}$.

**15.** In an example like $11\frac{1}{4} - 4\frac{3}{4}$, why is it necessary to change the form of $11\frac{1}{4}$ to $10\frac{5}{4}$ in order to complete the example?

Show that $11\frac{1}{4}$ equals $10\frac{5}{4}$.

**16.** Show why the following statements are correct:

*a.* $5\frac{1}{4} = 4\frac{5}{4}$ *c.* $5\frac{1}{2} = 4\frac{6}{4}$

*b.* $6\frac{2}{5} = 5\frac{7}{5}$ *d.* $7\frac{1}{4} = 6\frac{10}{8}$

**17.** Show how cancellation may be used in working the example $4\frac{1}{2} \times \frac{2}{3} =$

**18.** Explain clearly the steps used in working this example,

$$4\tfrac{1}{2} \div 3 = \tfrac{9}{2} \times \tfrac{1}{3} = \tfrac{3}{2} = 1\tfrac{1}{2}$$

**FINDING HARD SPOTS IN REDUCTION OF FRACTIONS**

This exercise contains the hard spots in the reduction of fractions. Do not be satisfied until you can work all the examples correctly.

**1.** Reduce the following fractions to lowest terms:

*a.* $\frac{8}{12}$ = *b.* $\frac{14}{21}$ = *c.* $\frac{16}{20}$ = *d.* $\frac{8}{10}$ = *e.* $\frac{12}{16}$ =

**2.** Supply the missing terms in each of the following:

*a.* $\frac{1}{2} = \frac{\quad}{4} = \frac{\quad}{10}$ *d.* $\frac{7}{8} = \frac{\quad}{24} = \frac{14}{\quad}$

*b.* $\frac{3}{4} = \frac{\quad}{16} = \frac{\quad}{12}$ *e.* $\frac{\quad}{4} = \frac{5}{20} = \frac{\quad}{24}$

*c.* $\frac{3}{5} = \frac{\quad}{10} = \frac{\quad}{15}$ *f.* $\frac{2}{3} = \frac{12}{\quad} = \frac{20}{\quad}$

**3.** Change the following improper fractions to whole or mixed numbers. Express all answers in lowest terms:

*a.* $\frac{4}{3}$ = *c.* $\frac{16}{6}$ = *e.* $\frac{16}{8}$ = *g.* $\frac{4}{4}$ =

*b.* $\frac{9}{8}$ = *d.* $\frac{14}{4}$ = *f.* $\frac{13}{8}$ = *h.* $\frac{9}{3}$ =

**4.** Change to improper fractions:

*a.* $1\frac{1}{3}$ = *b.* $2\frac{1}{4}$ = *c.* $6\frac{2}{3}$ = *d.* $4\frac{3}{5}$ = *e.* $5\frac{5}{8}$ =

**5.** Supply the missing numerators in the following:

*a.* $5\frac{1}{2} = 4\frac{\quad}{2}$ *c.* $6\frac{2}{3} = 5\frac{\quad}{3}$ *e.* $5 = 4\frac{\quad}{5}$

*b.* $2\frac{1}{2} = 1\frac{\quad}{4}$ *d.* $4\frac{2}{3} = 3\frac{\quad}{6}$ *f.* $8\frac{7}{8} = 7\frac{\quad}{24}$

**6.** Reduce the following to simplest form:

*a.* $4\frac{8}{4}$ = *b.* $7\frac{4}{4}$ = *c.* $14\frac{12}{7}$ = *d.* $16\frac{12}{8}$ =

**7.** Change these pairs of unlike fractions to fractions with a lowest common denominator:

*a.* $\frac{1}{3} = \frac{2}{6}$ $\frac{1}{6} = \frac{1}{6}$ *b.* $\frac{5}{8} =$ $\frac{1}{4} =$ *c.* $\frac{2}{3} =$ $\frac{1}{2} =$ *d.* $\frac{5}{8} =$ $\frac{5}{6} =$ *e.* $\frac{3}{4} =$ $\frac{2}{3} =$

**8.** Change $\frac{1}{4}$, $\frac{1}{6}$, and $\frac{1}{8}$ to fractions having a lowest common denominator.

**9.** Change $\frac{1}{2}$, $\frac{2}{5}$, and $\frac{3}{4}$ to twentieths.

**10.** Express as fractional parts of 100: 25; $12\frac{1}{2}$; $33\frac{1}{3}$; $62\frac{1}{2}$.

## STUDY HELPS IN ADDING AND SUBTRACTING FRACTIONS

Before fractions are added or subtracted they must be changed to a common denominator. Study the following examples carefully and be prepared to explain how each example was worked:

**1.** $\frac{1}{8} + \frac{1}{4} + \frac{1}{2} = ?$

$\frac{1}{8} = \frac{1}{8}$
$\frac{1}{4} = \frac{2}{8}$
$\frac{1}{2} = \frac{4}{8}$
$\frac{7}{8}$

**2.** $3\frac{1}{3} + 2\frac{1}{4} + 4\frac{1}{4} = ?$

$3\frac{1}{3} = 3\frac{4}{12}$
$2\frac{1}{4} = 2\frac{3}{12}$
$4\frac{1}{4} = 4\frac{3}{12}$
$9\frac{10}{12} = 9\frac{5}{6}$

**3.** $7\frac{3}{8} + 4\frac{5}{6} + \frac{3}{4} = ?$

$7\frac{3}{8} = 7\frac{9}{24}$
$4\frac{5}{6} = 4\frac{20}{24}$
$\frac{3}{4} = \frac{18}{24}$
$11\frac{47}{24} = 12\frac{23}{24}$

Copy examples **1, 2,** and **3,** and work them with your book closed. Compare your solutions with the work above.

The following examples contain the chief difficulties in subtraction of fractions. Study the work carefully and be ready to explain each step:

**4.** $4\frac{1}{2} - 1\frac{1}{6} = ?$

$4\frac{1}{2} = 4\frac{3}{6}$
$-1\frac{1}{6} = -1\frac{1}{6}$
$3\frac{2}{6} = 3\frac{1}{3}$

**5.** $4\frac{1}{8} - \frac{1}{8} = ?$

$4\frac{1}{8}$
$-\frac{1}{8}$
$4$

**6.** $8 - 4\frac{1}{3} = ?$

$8 = 7\frac{3}{3}$
$-4\frac{1}{3} = -4\frac{1}{3}$
$3\frac{2}{3}$

**7.** $5\frac{1}{4} - 1\frac{3}{4} = ?$

$5\frac{1}{4} = 4\frac{5}{4}$
$-1\frac{3}{4} = -1\frac{3}{4}$
$3\frac{2}{4} = 3\frac{1}{2}$

**8.** $6\frac{1}{3} - 2\frac{5}{6} = ?$

$6\frac{1}{3} = 6\frac{2}{6} = 5\frac{8}{6}$
$-2\frac{5}{6} = -2\frac{5}{6} = -2\frac{5}{6}$
$3\frac{3}{6} = 3\frac{1}{2}$

Copy examples **4** to **8** and work them with your book closed. Compare your work with the work above.

Give each step in working these examples:

*a.* $\frac{3}{4} + 2\frac{5}{8} + 6\frac{2}{3} = ?$ *b.* $7\frac{1}{8} - 2\frac{1}{6} = ?$

**If you ever have difficulty in adding or subtracting fractions, study again the solutions on this page.**

## FINDING HARD SPOTS IN ADDITION OF FRACTIONS

This page will help you to find the kinds of examples in addition of fractions that are hard for you. Be sure to get each answer in its simplest form, reducing whenever necessary.

### Set I

| | *a* | *b* | *c* | *d* | *e* | *f* | *g* |
|---|---|---|---|---|---|---|---|
| 1. | $\frac{1}{3}$ | $\frac{1}{8}$ | $\frac{1}{2}$ | $\frac{4}{5}$ | $\frac{3}{4}$ | $\frac{1}{2}$ | $\frac{1}{2}$ |
| | $\frac{1}{3}$ | $\frac{5}{8}$ | $\frac{1}{2}$ | $\frac{2}{5}$ | $\frac{3}{4}$ | $\frac{1}{4}$ | $\frac{1}{6}$ |
| 2. | 5 | $\frac{2}{3}$ | 4 | $3\frac{1}{2}$ | $2\frac{3}{4}$ | $\frac{7}{8}$ | $\frac{1}{3}$ |
| | $\frac{1}{4}$ | 7 | $1\frac{2}{3}$ | 8 | 4 | $\frac{1}{4}$ | $\frac{5}{6}$ |
| 3. | $3\frac{1}{5}$ | $7\frac{1}{4}$ | $2\frac{1}{3}$ | $3\frac{3}{5}$ | $5\frac{5}{6}$ | $\frac{7}{12}$ | $\frac{6}{7}$ |
| | $2\frac{1}{5}$ | $2\frac{1}{4}$ | $7\frac{2}{3}$ | $2\frac{3}{5}$ | $2\frac{5}{6}$ | $\frac{3}{4}$ | $\frac{3}{5}$ |

### Set II

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | $3\frac{2}{3}$ | $1\frac{1}{4}$ | $1\frac{2}{3}$ | $7\frac{3}{4}$ | $2\frac{2}{3}$ | $\frac{1}{4}$ | $\frac{1}{5}$ |
| | $2\frac{1}{6}$ | $3\frac{1}{12}$ | $2\frac{1}{12}$ | $3\frac{1}{2}$ | $7\frac{5}{6}$ | $\frac{1}{3}$ | $\frac{2}{3}$ |
| 2. | $4\frac{1}{5}$ | $1\frac{1}{6}$ | $3\frac{3}{4}$ | $6\frac{2}{3}$ | $5\frac{3}{5}$ | $\frac{5}{8}$ | $\frac{3}{5}$ |
| | $1\frac{1}{4}$ | $7\frac{3}{5}$ | $2\frac{1}{6}$ | $4\frac{3}{4}$ | $7\frac{7}{8}$ | $\frac{5}{12}$ | $\frac{1}{2}$ |
| 3. | $5\frac{1}{12}$ | $\frac{2}{5}$ | $\frac{2}{3}$ | $2\frac{5}{6}$ | $\frac{5}{6}$ | $1\frac{5}{6}$ | $\frac{1}{2}$ |
| | $\frac{5}{6}$ | $1\frac{2}{3}$ | $4\frac{5}{12}$ | $\frac{3}{8}$ | $1\frac{2}{3}$ | $2\frac{7}{8}$ | $6\frac{1}{4}$ |
| | $2\frac{1}{4}$ | $2\frac{1}{2}$ | $\frac{5}{6}$ | $\frac{1}{2}$ | $4\frac{3}{4}$ | $3\frac{1}{4}$ | $3\frac{5}{8}$ |

If you worked any of the examples incorrectly, what were the reasons for the errors? When you are sure that you know how to work every example correctly, practise until you can work the examples in each set correctly in *less than ten minutes.*

## FRACTIONS USED IN ATHLETIC RECORDS

This table shows what boys and girls of your age should be able to do in several kinds of athletic events. Look in the column corresponding to your age and compare your own records with those in the table.

The pole vault

| Event | 11 Years | 12 Years | 13 Years | 14 Years |
|---|---|---|---|---|
| Girls | | | | |
| 50-yd. dash | $10\frac{3}{5}$ sec. | 10 sec. | $9\frac{2}{5}$ sec. | 9 sec. |
| 60-yd. low hurdles | $12\frac{3}{5}$ sec. | 12 sec. | $11\frac{2}{5}$ sec. | 11 sec. |
| Standing broad jump | 5′ 1″ | 5′ 3″ | 5′ 5″ | 5′ 6″ |
| Boys | | | | |
| 50-yd. dash | $8\frac{2}{5}$ sec. | 8 sec. | $7\frac{4}{5}$ sec. | $7\frac{3}{5}$ sec. |
| Standing broad jump | 5′ 0″ | 5′ 3″ | 5′ 6″ | 5′ 9″ |
| High jump | 2′ 6″ | 2′ 8″ | 2′ 10″ | 3′ 0″ |
| Running broad jump | 8′ 0″ | 8′ 6″ | 9′ 0″ | 9′ 6″ |

**1.** How much longer does it take an 11-year-old girl to run 50 yards than it takes a boy of the same age to run that distance?

**2.** How much faster should a 14-year-old girl be able to run the 60-yard low hurdles than an 11-year-old girl?

**3.** In the high jump, Harry, 11 years old, jumped 2 feet $4\frac{1}{2}$ inches. How much less than normal was his jump?

**4.** Mary and Jack do a standing broad jump. Mary, 11 years old, jumps 4 feet $10\frac{1}{2}$ inches. Jack, 12 years old, jumps 5 feet $6\frac{3}{4}$ inches. How far from normal was Mary's jump? How far beyond normal was Jack's jump? How much farther than Mary did Jack jump?

## FINDING HARD SPOTS IN SUBTRACTION OF FRACTIONS

Work the following examples carefully. Check your work at each step. Be sure to get the answer in its simplest form. After your paper has been marked, find the reasons for your errors.

### Set I

| | *a* | *b* | *c* | *d* | *e* | *f* | *g* |
|---|---|---|---|---|---|---|---|
| 1. | $\frac{2}{3}$ | $\frac{5}{6}$ | $\frac{3}{8}$ | $4\frac{3}{5}$ | $6\frac{2}{3}$ | $9\frac{7}{8}$ | 8 |
| | $\frac{1}{3}$ | $\frac{1}{6}$ | $\frac{3}{8}$ | $\frac{2}{5}$ | $\frac{2}{3}$ | $4\frac{3}{8}$ | $\frac{1}{2}$ |
| 2. | $7\frac{7}{8}$ | $6\frac{1}{2}$ | $3\frac{1}{8}$ | $4\frac{4}{5}$ | $6\frac{7}{8}$ | 1 | 4 |
| | $\frac{1}{8}$ | 4 | 3 | $2\frac{1}{5}$ | $1\frac{7}{8}$ | $\frac{1}{6}$ | $1\frac{2}{5}$ |

### Set II

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | $7\frac{1}{3}$ | $8\frac{1}{8}$ | $18\frac{1}{5}$ | $9\frac{1}{3}$ | $8\frac{1}{6}$ | $8\frac{5}{6}$ | $8\frac{3}{5}$ |
| | $\frac{2}{3}$ | $\frac{5}{8}$ | $6\frac{2}{5}$ | $8\frac{2}{3}$ | $1\frac{5}{6}$ | $1\frac{2}{3}$ | $2\frac{1}{10}$ |
| 2. | $\frac{1}{4}$ | $\frac{1}{2}$ | $3\frac{7}{8}$ | $6\frac{1}{2}$ | $8\frac{1}{3}$ | $6\frac{2}{3}$ | $8\frac{1}{4}$ |
| | $\frac{1}{8}$ | $\frac{1}{6}$ | $\frac{1}{2}$ | $6\frac{1}{4}$ | $\frac{1}{12}$ | $\frac{5}{6}$ | $\frac{11}{12}$ |

### Set III

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | $\frac{3}{4}$ | $\frac{7}{8}$ | $3\frac{5}{8}$ | $7\frac{5}{6}$ | $1\frac{1}{8}$ | $9\frac{7}{8}$ | $6\frac{1}{4}$ |
| | $\frac{1}{3}$ | $\frac{5}{6}$ | $\frac{1}{3}$ | $\frac{3}{8}$ | $\frac{1}{3}$ | $2\frac{11}{12}$ | $\frac{5}{6}$ |
| 2. | $8\frac{5}{6}$ | $8\frac{7}{8}$ | $8\frac{5}{6}$ | $9\frac{1}{8}$ | $8\frac{1}{8}$ | $9\frac{1}{4}$ | $4\frac{1}{5}$ |
| | $1\frac{2}{5}$ | $2\frac{1}{6}$ | $2\frac{3}{4}$ | $1\frac{1}{2}$ | $\frac{1}{4}$ | $2\frac{2}{3}$ | $\frac{2}{3}$ |

After you are sure that you know how to work every example, practise for speed until you can work the examples in each set in *less than five minutes.*

### DIFFICULTIES IN MULTIPLICATION OF FRACTIONS

Study the following examples carefully before beginning the practice exercises on page 26. When you think you understand the work, copy the examples and solve them. Compare your work with the work below.

**1.** $7 \times \frac{1}{8} = ?$ **2.** $\frac{3}{4} \times 2 = ?$

$$7 \times \tfrac{1}{8} = \frac{7 \times 1}{8} = \tfrac{7}{8} \qquad \tfrac{3}{4} \times 2 = \frac{3 \times 2}{4} = \tfrac{6}{4} = 1\tfrac{2}{4} = 1\tfrac{1}{2}$$

*When multiplying a fraction and a whole number, multiply the numerator of the fraction by the whole number. Place the product over the denominator. Reduce the result to simplest form.*

**3.** $\frac{3}{4} \times \frac{5}{7} = ?$ **4.** $\frac{4}{5} \times \frac{5}{16} = ?$

$$\tfrac{3}{4} \times \tfrac{5}{7} = \frac{3 \times 5}{4 \times 7} = \tfrac{15}{28} \qquad \tfrac{\cancel{4}^{1}}{\cancel{5}^{1}} \times \tfrac{\cancel{5}^{1}}{\cancel{16}^{4}} = \frac{1 \times 1}{1 \times 4} = \tfrac{1}{4}$$

*When multiplying two fractions, multiply the two numerators together to find the numerator of the answer and the two denominators to find the denominator of the answer.* Use cancellation when possible.

**5.** $2\frac{1}{2} \times 3\frac{1}{2} = ?$

$$\tfrac{5}{2} \times \tfrac{7}{2} = \frac{5 \times 7}{2 \times 2} = \tfrac{35}{4} = 8\tfrac{3}{4}$$

*In multiplying mixed numbers, change them to improper fractions and multiply.*

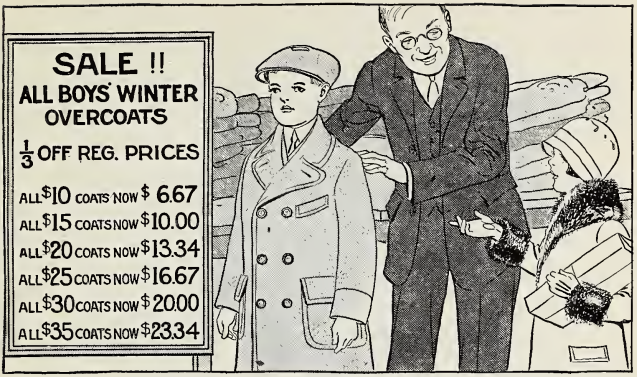
**6.** Show how cancellation can be used in working this example: $\frac{3}{4} \times 1\frac{1}{3} \times \frac{1}{2}$.

**7.** What does three-fourths of a $1\frac{1}{2}$-pound package of spices weigh?

Think: $\frac{3}{4}$ of $1\frac{1}{2}$ lb. = ? Remember that "of" means ($\times$).
$\frac{3}{4}$ of $1\frac{1}{2}$ lb. $= \frac{3}{4} \times 1\frac{1}{2} = \frac{3}{4} \times \frac{3}{2} = \frac{9}{8} = 1\frac{1}{8}$ lb.

**8.** Reduce the following to improper fractions:

$$3\tfrac{1}{2},\ 7\tfrac{1}{4},\ 5\tfrac{2}{3},\ 6\tfrac{7}{8},\ 7\tfrac{3}{4},\ 5\tfrac{2}{5},\ 1\tfrac{1}{6},\ 3\tfrac{1}{3}.$$


SALE !!
ALL BOYS' WINTER OVERCOATS
1/3 OFF REG. PRICES
ALL $10 COATS NOW $ 6.67
ALL $15 COATS NOW $10.00
ALL $20 COATS NOW $13.34
ALL $25 COATS NOW $16.67
ALL $30 COATS NOW $ 20.00
ALL $35 COATS NOW $23.34

This advertisement appeared in a daily paper.

**1.** Check over the figures and see if exactly $\frac{1}{3}$ is taken off.

**2.** If $\frac{1}{3}$ is taken off the regular price, what fraction of the regular price is the sale price?

**3.** Albert bought a \$25 overcoat at the advertised price. What change did he get from a twenty-dollar bill?

**4.** Albert noticed some handkerchiefs marked to sell at 35¢ each. If the handkerchiefs were regularly priced at 50¢ each, what was the reduction on 10 handkerchiefs?

**5.** How much will Albert save if he buys a half dozen 30¢ handkerchiefs at the sale price of $\frac{1}{3}$ off?

**6.** The merchant tells him that the neckties are priced at $\frac{1}{3}$ off. Make a table like the one above showing the regular and sale prices of neckties regularly priced at 50¢; 75¢; \$1.00; \$1.15; \$1.50; and \$2.00.

**7.** A store advertised its women's fall coats at $\frac{1}{4}$ off. The coats were marked at \$12, \$15, \$18, \$21, \$30, and \$54. Find the regular prices of these coats.

## HARD SPOTS IN MULTIPLICATION OF FRACTIONS

Work these multiplication examples with great care. Check your work at each step. Use cancellation whenever possible. Be sure to get each answer in its simplest form.

### Set I

| | *a* | *b* | *c* |
|---|---|---|---|
| 1. | $\frac{1}{3} \times 6 =$ | $\frac{1}{8}$ of $2 =$ | $\frac{2}{5}$ of $2 =$ |
| 2. | $\frac{2}{5}$ of $17 =$ | $\frac{5}{6}$ of $20 =$ | $\frac{7}{8} \times \frac{4}{5} =$ |
| 3. | $3 \times \frac{2}{7} =$ | $4 \times \frac{1}{4} =$ | $6 \times \frac{1}{3} =$ |
| 4. | $14 \times \frac{1}{5} =$ | $9 \times \frac{1}{6} =$ | $\frac{16}{25} \times \frac{5}{8} \times \frac{1}{2} =$ |
| 5. | $\frac{1}{3}$ of $\frac{1}{4} =$ | $\frac{1}{3} \times \frac{6}{7} =$ | $\frac{1}{3} \times \frac{5}{9} =$ |

### Set II

| | | | |
|---|---|---|---|
| 1. | $8 \times 2\frac{1}{4} =$ | $5 \times 4\frac{1}{3} =$ | $10 \times 3\frac{3}{4} =$ |
| 2. | $4 \times 2\frac{1}{5} =$ | $3\frac{3}{8} \times 6 \times 2\frac{4}{5} =$ | $\frac{3}{5} \times 4\frac{1}{4} =$ |
| 3. | $2\frac{1}{3} \times \frac{1}{3} =$ | $4\frac{1}{4} \times 3 =$ | $6\frac{1}{8} \times 6 =$ |
| 4. | $4\frac{2}{3} \times 8 =$ | $3\frac{3}{8} \times 6 \times 2\frac{2}{3} =$ | $\frac{3}{4} \times 5\frac{1}{6} \times \frac{2}{3} =$ |
| 5. | $\frac{1}{4} \times 3\frac{1}{2} =$ | $\frac{1}{2}$ of $1\frac{1}{3} =$ | $\frac{7}{8} \times 9\frac{3}{5} =$ |

### Set III

| | | | |
|---|---|---|---|
| 1. | $3\frac{1}{3} \times \frac{2}{9} =$ | $4\frac{2}{3} \times \frac{1}{8} =$ | $3\frac{1}{3} \times \frac{3}{5} =$ |
| 2. | $6\frac{3}{5} \times \frac{3}{7} =$ | $4\frac{3}{4} \times \frac{3}{8} \times 5 =$ | $3\frac{2}{7} \times 2\frac{2}{3} =$ |
| 3. | $2\frac{1}{4} \times 2\frac{1}{2} =$ | $6\frac{2}{5} \times 6\frac{1}{4} =$ | $3\frac{3}{4} \times 3\frac{1}{3} =$ |

| 4. | 5. | 6. | 7. | 8. |
|---|---|---|---|---|
| $32$ | $36\frac{7}{8}$ | $16$ | $38\frac{1}{4}$ | $24$ |
| $4\frac{1}{8}$ | $16$ | $24\frac{5}{6}$ | $15$ | $39\frac{4}{5}$ |

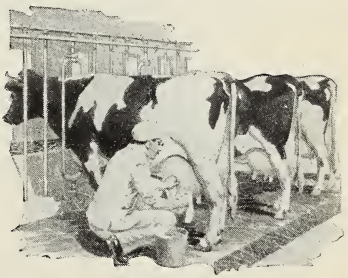
After you are sure that you know how to work the examples, practise for speed until you can work all of the examples in each set correctly in *less than five minutes.*

### ON A DAIRY FARM

Ethel's father, Mr. Morton, bought a dairy farm. Here are some of the problems he had to work in buying the farm and in deciding what he would raise on it the first year.

**1.** There were 120 acres in the farm. Forty acres of it cost \$120 an acre, and the remaining 80 acres cost \$210 an acre. What did Mr. Morton pay for the farm?

**2.** Mr. Morton bought 15 dairy cows. For three Holstein cows he paid \$540, and for the rest an average of \$125 a cow. What did he pay in all for the cows?



**3.** For pasture Mr. Morton allowed $\frac{3}{4}$ acre for each cow. How many acres did he need for pasture in all?

**4.** For hay he allowed $1\frac{1}{4}$ acres for each cow. How many acres did he allow for hay?

**5.** For silage he allowed $1\frac{1}{8}$ acres for each cow. How much did he allow for silage?

**6.** He planted $\frac{3}{4}$ acre of oats for each cow. How many acres were needed to produce the oats for the cows?

**7.** He planted $\frac{7}{8}$ acre of barley for each cow. How many acres of barley did he plant?

**8.** How many acres did he use in all for pasture, hay, silage, oats, and barley?

**9.** How many acres were needed to provide pasture, hay, silage, oats, and barley for one cow?

## TWO WAYS OF COMPARING NUMBERS

**Comparing numbers by subtraction.** Study the following problems to see what numbers are compared and how they are compared:

**1.** Alice weighs $87\frac{3}{4}$ pounds. Arthur weighs $91\frac{1}{2}$ pounds. How much heavier than Alice is Arthur?

*Think:* $91\frac{1}{2}$ lb. $- 87\frac{3}{4}$ lb. $= ?$

**2.** Harry can run 100 yards in $11\frac{2}{5}$ seconds. John can run the distance in 13 seconds. How much longer does John take to run 100 yards than Harry?

In these problems the numbers were compared by subtraction.

**Comparing numbers by division or ratio.** Numbers may also be compared by division.

**1.** A fountain pen costs \$2.50 and a pencil costs \$.05. A fountain pen costs how many times as much as a pencil?

*Think:* \$2.50 $\div$ \$.05 $= 50$; hence, a fountain pen costs 50 times as much as a pencil.

When two numbers are compared by division, their *ratio* is found.

**2.** What is the ratio of 10 to 20?

*Think:* $10 \div 20 = \frac{1}{2}$; hence, 10 is $\frac{1}{2}$ of 20.

**3.** Compare 25 and 10.

*Think:* $25 \div 10 = \frac{25}{10} = 2\frac{1}{2}$; hence, 25 is $2\frac{1}{2}$ times 10.

**4.** What part of a bushel is 16 quarts?

*Think:* There are 32 quarts in a bushel. 16 is what part of 32? $\frac{16}{32}$ expresses the comparison. $\frac{16}{32} = \frac{1}{2}$; hence, 16 quarts is $\frac{1}{2}$ bushel.

**5.** What part of 100 is $16\frac{2}{3}$?

**6.** What part of 100 is $12\frac{1}{2}$? $37\frac{1}{2}$? $62\frac{1}{2}$? $66\frac{2}{3}$? $83\frac{1}{3}$?

**7.** What part of a mile is 220 yards? 880 yards?

### STUDY HELPS IN DIVIDING FRACTIONS

When dividing fractions be sure to invert the divisor.

| | |
|---|---|
| **1.** $5\frac{1}{2} \div \frac{2}{3} = ?$<br>$5\frac{1}{2} \div \frac{2}{3} =$<br>$\frac{11}{2} \times \frac{3}{2} = \frac{11 \times 3}{2 \times 2} = \frac{33}{4}$<br>$\frac{3}{4}\frac{3}{3} = 8\frac{1}{4}$ | **3.** $7\frac{1}{2} \div 5 = ?$<br>$7\frac{1}{2} \div 5 =$<br>$\frac{\cancel{15}^{3}}{2} \times \frac{1}{\cancel{5}_{1}} = \frac{3 \times 1}{2 \times 1} = \frac{3}{2} = 1\frac{1}{2}$ |
| **2.** $8 \div 1\frac{1}{3} = ?$<br>$8 \div 1\frac{1}{3} =$<br>$\frac{8}{1} \div \frac{4}{3} = \frac{\cancel{8}^{2}}{1} \times \frac{3}{\cancel{4}_{1}} =$<br>$\frac{2 \times 3}{1 \times 1} = 6$ | **4.** $\frac{2}{3} \div \frac{3}{4} = ?$<br>$\frac{2}{3} \div \frac{3}{4} =$<br>$\frac{2}{3} \times \frac{4}{3} = \frac{2 \times 4}{3 \times 3} = \frac{8}{9}$ |

Important types of division examples.

**If later you have difficulty in dividing fractions, study again the solutions on this page.**

**5.** What is meant by inverting a number? What numbers in division examples **1** to **4** were inverted in working the examples?

**6.** Give the inverted forms of the following:

$\frac{2}{3}$, $\frac{3}{4}$, $2\frac{1}{2}$, 6, $7\frac{1}{2}$, $\frac{4}{5}$, 3, $6\frac{2}{3}$.

**7.** Copy examples **1** to **4** on a separate piece of paper. Then work the examples with your book closed.

**8.** What is the most important thing to remember when dividing fractions?

## HARD SPOTS IN DIVISION OF FRACTIONS

The following sets of examples will help you to discover your difficulties in the division of fractions. Check your work at each step. Be sure to get the answers in their simplest forms:

### Set I

| | *a* | *b* | *c* |
|---|---|---|---|
| 1. | $6 \div \frac{1}{2} =$ | $5 \div \frac{3}{5} =$ | $12 \div \frac{3}{4} =$ |
| 2. | $10 \div \frac{4}{5} =$ | $2 \div \frac{6}{7} =$ | $2\frac{5}{8} \div \frac{3}{4} =$ |
| 3. | $\frac{1}{3} \div \frac{1}{2} =$ | $\frac{1}{6} \div \frac{1}{3} =$ | $\frac{5}{6} \div \frac{5}{6} =$ |
| 4. | $\frac{11}{15} \div \frac{1}{4} =$ | $\frac{5}{6} \div \frac{3}{10} =$ | $3\frac{1}{3} \div \frac{2}{3} =$ |
| 5. | $1\frac{1}{3} \div \frac{1}{2} =$ | $1\frac{1}{4} \div \frac{1}{4} =$ | $4\frac{5}{6} \div \frac{3}{10} =$ |

### Set II

| | | | |
|---|---|---|---|
| 1. | $\frac{1}{2} \div 2 =$ | $\frac{5}{6} \div 3 =$ | $\frac{7}{8} \div 7 =$ |
| 2. | $\frac{6}{7} \div 8 =$ | $\frac{3}{4} \div 1 =$ | $\frac{1}{6} \div 1\frac{1}{3} =$ |
| 3. | $1\frac{1}{3} \div 7 =$ | $2\frac{2}{5} \div 8 =$ | $8\frac{1}{3} \div 6 =$ |
| 4. | $4\frac{2}{5} \div 2 =$ | $2\frac{1}{2} \div 5 =$ | $\frac{9}{16} \div 2\frac{1}{4} =$ |
| 5. | $\frac{1}{4} \div 1\frac{1}{3} =$ | $\frac{3}{8} \div 2\frac{1}{3} =$ | $\frac{5}{6} \div 4\frac{1}{3} =$ |

### Set III

| | | | |
|---|---|---|---|
| 1. | $4 \div 4\frac{1}{2} =$ | $5 \div 7\frac{1}{2} =$ | $10 \div 2\frac{1}{2} =$ |
| 2. | $5 \div 2\frac{3}{4} =$ | $18 \div 6\frac{3}{5} =$ | $\frac{3}{4} \div \frac{3}{4} =$ |
| 3. | $1\frac{1}{5} \div 2\frac{1}{2} =$ | $1\frac{1}{3} \div 6\frac{2}{3} =$ | $7\frac{1}{6} \div 7\frac{1}{6} =$ |
| 4. | $5\frac{1}{3} \div 2\frac{1}{4} =$ | $9\frac{1}{2} \div 3\frac{1}{6} =$ | $8\frac{1}{2} \div 2\frac{1}{8} =$ |
| 5. | $15 \div 7\frac{1}{2} =$ | $16\frac{2}{3} \div 5 =$ | $1 \div \frac{1}{5} =$ |

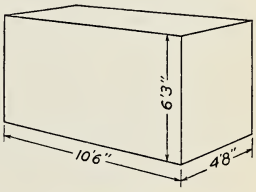
After you are sure that you know how to work every example, practise for speed until you can complete the examples in each set in *less than five minutes.*

### CONTENTS OF A BOX

Harry wanted to find how many bushels there were in a large box that he had filled with potatoes.

*a.* He knew that a bushel is approximately equal to $1\frac{1}{4}$ cubic feet. Explain what a cubic foot is.

*b.* He knew that the volume of a box is found by multiplying the length by the width by the height.




**1.** The dimensions of the box are shown in the drawing. How many cubic feet does the box contain?

10′ 6″ by 4′ 8″ by 6′ 3″ = the volume.

To find the volume, change the dimensions to feet, for example 10′ 6″ is $10\frac{1}{2}$ feet. Then find the volume in cubic feet. Divide the volume by $1\frac{1}{4}$ to find the approximate number of bushels.

**2.** How many cubic inches are there in a box 8 inches long, 6 inches wide, and 1 foot 2 inches deep?

**3.** What is the cubic capacity of a room 15 feet long, 18 feet wide, and 10 feet high?

**4.** Find the volume of a box 5 feet 6 inches wide, 3 feet 4 inches long, and 6 feet 3 inches deep.

Find the volumes of the following:

**5.** A cake of ice, 10″ by 14″ by 15″.

**6.** A box, 3′ 6″ by 2′ 4″ by 3′ 1″.

**7.** A tank, 40′ by 20′ by 5′ 6″.

**8.** A bin, 7′ by 8′ 4″ by 9′.

In expressing dimensions, the sign "×" is read "by": 3′ × 5′ = 3′ by 5′.

### THE ARITHMETIC OF A CLERK

On Saturdays Jack Andrews works in his father's store. Below is a list of some of the sales which Jack made.

Find the amount which must be rung up on the cash register for each of the following sales:

**1.** 8 ounces of cheese at 42 cents a pound.

**2.** 12 ounces of cheese at 42 cents a pound.

**3.** 1 pound 5 ounces of meat at 40 cents a pound.

**4.** 3 pounds 15 ounces of sausage at 35 cents a pound.

**5.** $3\frac{3}{4}$ pounds of crackers at 16 cents a pound.

**6.** 3 pecks of potatoes at $1.20 a bushel.

**7.** 3 quarts of vinegar at $.60 a gallon.

**8.** $1\frac{1}{2}$ yards of ribbon at $.40 a yard.

**9.** 1 yard 12 inches of ribbon at $.50 a yard.

**10.** 75 pounds of sugar at $5.65 a hundred pounds.

**11.** 125-pound bale of hay at $1.20 a hundred pounds.

**12.** 18 oranges at $.45 a dozen.

**13.** 6 cans of peaches at 3 cans for $.64.

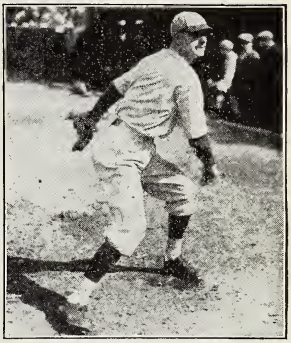
**14.** If you were helping in a store, how many ounces of cheese at $.40 a pound would you sell for $.24? for $.30? for $.15?

**15.** If 10 pounds of sugar cost $.74, how much would you charge for 5 pounds? How much for 6 pounds?

**16.** At the rate of $.20 a half pint, how much would you charge for 5 gallons of cream sold in half-pint bottles?

**17.** If a $4\frac{1}{2}$-pound package of cookies sold for $1.20, how much was the cost a pound?

## PRACTICE TESTS AND HOW TO USE THEM



Just as a baseball player must practise to keep his skill at a high level, you will need to practise from time to time to keep your arithmetic skill up to standard.

At the close of each chapter in this book, you will find practice tests in various processes. Take these tests as your teacher directs. She will time your work and will tell you when to begin and when to stop working.

**Practice test in fractions—Number I.** Practise on this set until you can work all of the examples correctly in less than five minutes:

| | | |
|---|---|---|
| **1.** $\frac{1}{4} + \frac{2}{3} =$ | **5.** $\frac{8}{9} \div 4 =$ | **9.** $25\frac{2}{5} - \frac{5}{9} =$ |
| **2.** $9 - \frac{7}{8} =$ | **6.** $\frac{5}{6} + 9\frac{1}{3} =$ | **10.** $\frac{6}{7} \times 4\frac{1}{5} =$ |
| **3.** $\frac{4}{5}$ of $6 =$ | **7.** $16\frac{7}{8} \div 3 =$ | **11.** $2\frac{1}{4} + 3\frac{7}{9} =$ |
| **4.** $\frac{7}{8} \times \frac{4}{11} =$ | **8.** $9\frac{1}{3} \div \frac{7}{9} =$ | **12.** $6 \div 4\frac{4}{5} =$ |

Keep a record of your results in this test so that you can compare it with your work on the next test in fractions.

Make a record of your scores on three trials of this test as follows:

| Trial | Time | Number Attempted | Number Correct |
|---|---|---|---|
| 1..... | | | |
| 2..... | | | |
| 3..... | | | |

**Place value in the decimal system.** For hundreds of years people used the places to the *left* of units to express numbers equal to ten or more. It was not until about 1585 that an arithmetic appeared that used the places to the *right* of units to express numbers less than one. A *decimal point* was inserted to show that numbers were written to the right of the unit's place.

Our money system is a good illustration of the use of decimals. The word *decimal* comes from the Latin word, *decem*, which means "ten." The decimal system is based on tens; thus, to the left of the decimal point the digits are called *units*, *tens*, *hundreds*, *thousands*, etc.; to the right, *tenths*, *hundredths*, *thousandths*, etc.

| Millions' Period | | | Thousands' Period | | | Units' Period | | | Decimal Point | DECIMALS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hundred millions* | *Ten millions* | *Millions* | *Hundred thousands* | *Ten thousands* | *Thousands* | *Hundreds* | *Tens* | *Units* | (*and*) | *Tenths* | *Hundredths* | *Thousandths* | *Ten thousandths* | *Hundred thousandths* | *Millionths* |
| 2 | 6 | 3 | 4 | 7 | 8 | 6 | 5 | 2 | . | 9 | 4 | 3 | 7 | 2 | 6 |

1. In paying a bill of $11.11, a man presented one ten-dollar bill, one dollar bill, one dime, and one cent. In $11.11, which figure expresses ten dollars? one dollar? one dime? one cent?

2. What fractional part of one dollar ($1.00) is a dime ($.10)?

3. What fractional part of a dime is a cent ($.01)?

**4.** In \$11.11 each figure expresses .... as much as the figure to the left. Each figure expresses .... times as much as the figure to the right.

**5.** What fractional part of a dollar is a cent?

**6.** One tenth of a cent, or a *mill*, is what fractional part of a dollar?

One mill is written, \$.001. This is read: one thousandth of a dollar. The 1 is written in the third place to the right of the decimal point.

**7.** Which is greater, $\frac{7}{100}$ of a dollar or $\frac{3}{10}$ of a dollar?

**8.** Which is greater, .5 foot or .09 foot? \$.008 or \$.011? .375 yard or .98 yard?

**9.** Arrange these numbers in the order of their value, writing the largest number first.

*a.* 5.9, .59, .059, 59, 590.
*b.* 3.75, 48.6, .497, 25.0, .98.
*c.* 875, 64.2, .984, .002, .1.
*d.* 6.89, 7.0, .091, 64.5, 970.

***10.** Many librarians use the Dewey Decimal System in numbering books. This system makes it easy to arrange books on the shelves in an orderly manner and to classify them according to subjects. Look up this system and explain it to the class.

***11.** Tell why our system of measuring weight is not a decimal system.

***12.** Show that our system of measuring time is not a decimal system.

***13.** Show that our system of measuring length is not a decimal system.

***14.** Select three foreign countries and find whether or not their money systems are decimal systems.

### CHANGING DECIMALS TO COMMON FRACTIONS

Which weighs more, a load of coal weighing .875 ton or one weighing 1,800 pounds? One way to find out is to express both numbers as a fraction of a ton. Unless otherwise indicated in this book, use 2,000 *pounds* as a *ton.*

1. Change .875 ton to a common fraction.

$.875 \text{ T.} = \frac{875}{1000} \text{ T.} = \frac{7}{8} \text{ T.}$
$1{,}800 \text{ lb.} = \frac{1800}{2000} = \frac{9}{10} \text{ T.}$
Since $\frac{9}{10}$ is greater than $\frac{7}{8}$, 1,800 pounds is greater than .875 ton.

2. Change $.37\frac{1}{2}$ to a common fraction.

$$.37\tfrac{1}{2} = 37\tfrac{1}{2} \div 100 = \tfrac{75}{2} \times \tfrac{1}{100} = ?$$

3. Change 3.25 to a mixed number.

$$3.25 = 3 + \tfrac{25}{100} = ?$$

4. Change the following to common fractions:
   *a.* .25; *b.* .48; *c.* .7; *d.* .625; *e.* .125; *f.* .04; *g.* .05; *h.* .375.

5. Change the following to common fractions:
   *a.* $.12\frac{1}{2}$; *b.* $.33\frac{1}{3}$; *c.* $.66\frac{2}{3}$; *d.* $.37\frac{1}{2}$; *e.* $.7\frac{1}{2}$; *f.* $.87\frac{1}{2}$; *g.* $.62\frac{1}{2}$; *h.* $.3\frac{1}{3}$.

6. Change the following to mixed numbers:
   *a.* 1.25; *b.* 3.75; *c.* $4.62\frac{1}{2}$; *d.* $8.33\frac{1}{3}$; *e.* $7.6\frac{2}{3}$; *f.* 4.008.

*7. Choose ten decimals other than the decimals given in problems 4 to 6. Change the decimals to common fractions or to mixed numbers.

### CHANGING COMMON FRACTIONS TO DECIMALS

There are two methods of changing common fractions to decimals.

**1.** Change $\frac{4}{5}$ to a decimal.

| *Method A* | *Method B* |
|---|---|
| $\frac{4}{5} \times \frac{2}{2} = \frac{8}{10} = .8$ | $5\overline{)4.0}$ <br> .8 |

In *Method A* why did we multiply both the numerator and the denominator of $\frac{4}{5}$ by 2? How did we obtain the 2? In *Method B* we divided the numerator by the denominator. Which method do you prefer?

**2.** Change $\frac{3}{20}$ to a decimal fraction.

| *Method A* | *Method B* |
|---|---|
| $\frac{3}{20} \times \frac{5}{5} = \frac{15}{100} = .15$ | .15 <br> $20\overline{)3.00}$ <br> 20 <br> 100 <br> 100 |

**3.** Change $\frac{1}{3}$ to thousandths. Use *Method B*.

$3\overline{)1.000}$ .$333\frac{1}{3}$ Carrying the work to three decimal places is usually sufficient.

**4.** Change to decimals. Use both methods *A* and *B*.

*a.* $\frac{3}{5}$; *b.* $\frac{3}{4}$; *c.* $\frac{1}{4}$; *d.* $\frac{1}{2}$; *e.* $\frac{1}{5}$; *f.* $\frac{2}{5}$; *g.* $\frac{17}{20}$; *h.* $\frac{16}{25}$; *i.* $\frac{49}{50}$; *j.* $\frac{3}{20}$; *k.* $\frac{2}{25}$; *l.* $\frac{5}{8}$.

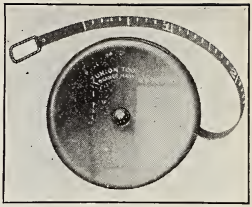
**5.** Change to thousandths. Use *Method B*.

*a.* $\frac{2}{3}$; *b.* $\frac{1}{8}$; *c.* $\frac{4}{9}$; *d.* $\frac{7}{12}$; *e.* $\frac{8}{15}$; *f.* $\frac{11}{18}$; *g.* $\frac{7}{8}$.

**6.** Change to decimal form. Use either method.

*a.* $2\frac{3}{4}$; *b.* $7\frac{1}{2}$; *c.* $6\frac{1}{3}$; *d.* $7\frac{3}{8}$; *e.* $5\frac{5}{6}$; *f.* $9\frac{2}{3}$.

## USING DECIMALS IN MEASURING



Surveyors use steel tapes to measure land. Instead of being divided into inches, each foot on the tape is divided into 100 equal parts. Each of these small parts is .01 foot long.

**1.** Draw a line 1 inch long. Is it easy to divide the line into ten equal parts? Why?

**2.** Which is longer and how much longer, .1 foot or 1 inch? Which is longer, .25 foot or 3 inches?

**3.** Express 1.5 feet as inches.

**4.** A surveyor measured a piece of valuable property in a city and found it to be 48.74 feet wide and 87.40 feet deep. How much greater than its width is its depth?

**5.** What is the distance around a small rectangular piece of land 47.25 feet long and 68.79 feet deep?

**6.** Two surveyors measured the length of a piece of land. One said that it was 98.74 feet long, and the other that it was 99.12 feet long. What is the difference between their measurements?

**7.** It is difficult to measure distances correctly to the nearest hundredth of a foot. In describing the length of a piece of land, Mr. Jordan, the surveyor, said, "This piece of land is 98.36 feet long, or 98.4 feet *correct to the nearest tenth of a foot*, or 98 feet long to the *nearest foot*." Express the following lengths correct to the nearest tenth of a foot; to the nearest foot:

***a.*** 4.78 ft.; ***b.*** 5.29 ft.; ***c.*** 6.42 ft.; ***d.*** 4.66 ft.; ***e.*** 7.09 ft.

***8.** Try to construct .375 of a foot.

### FINDING DIFFICULTIES IN ADDITION OF DECIMALS

☞(*a*) *Arrange the numbers so that the decimal points are in a line one under the other.* (*b*) *Add in one place at a time.* (*c*) *Place the decimal point in the answer directly under the line of decimal points in the number added.*

| | | | | |
|---|---|---|---|---|
| **1.** .1 | **3.** .4 | **5.** .17 | **7.** .39 | **9.** .04 |
| .4 | .6 | .29 | .48 | .02 |
| .2 | .9 | .42 | .65 | .02 |
| **2.** .09 | **4.** 3.1 | **6.** 1.84 | **8.** 4.35 | **10.** 3.37 |
| .07 | 4.2 | 6.47 | 3.625 | 5. |
| .06 | 5.9 | 5.84 | 5.5 | 11.1 |

**11.** 8.79 + 6.4 + 95 + .375.

**12.** 8.64 + 5.0 + .375 + 0.6.

### FINDING DIFFICULTIES IN SUBTRACTION OF DECIMALS

☞(*a*) *Place the decimal point in the subtrahend directly below the decimal point in the minuend.* (*b*) *Place the decimal point in the answer directly below the other two points.*

| | | | | |
|---|---|---|---|---|
| **1.** .9 | **5.** .8 | **9.** .16 | **13.** 1.8 | **17.** .47 |
| .4 | .8 | .07 | .9 | .24 |
| **2.** .58 | **6.** .489 | **10.** .9 | **14.** .8 | **18.** .7 |
| .53 | .279 | .75 | .375 | .008 |
| **3.** 9.7 | **7.** 18.6 | **11.** 27.13 | **15.** 9.5 | **19.** 18.7 |
| 3.2 | 4.9 | 14.26 | 6.25 | 5.725 |
| **4.** 28.47 | **8.** .97 | **12.** .375 | **16.** 9.874 | **20.** 4.748 |
| 3.6 | .9 | .25 | 6. | 4.7 |

### ON AN AUTOMOBILE TRIP

On an automobile trip last summer, Helen made a copy of the readings of the speedometer at the end of each day's run. This is the record for part of the trip:

| Total | Trip Meter Readings | |
|---|---|---|
| 11,460 | 00.0 | Monday morning |
| 11,710 | 50.6 | Monday evening |
| 11,996 | 36.2 | Tuesday evening |
| 12,110 | 55.4 | Wednesday evening |
| 12,368 | 08.9 | Thursday evening |
| 12,579 | 19.8 | Friday evening |

1. On Monday evening Helen said that they had travelled 250 miles. Her father said that they had travelled 250.6 miles. Who was correct?

2. How far did they travel on Tuesday? on Wednesday? on Thursday? on Friday?

3. What was the total distance travelled in the five days? Find the distance in two ways.

4. What was the average number of miles the car was driven daily?

5. One morning Helen's father bought 10 gallons of gasoline. The car uses, on the average, a gallon of gasoline in 14.75 miles. At this rate how many miles will the car travel if 10 gallons of gasoline are used?

6. One day they used only 10 gallons of gasoline in going a distance of 156.7 miles. How many miles did they travel, on the average, for each gallon of gasoline used?

*7. Tell how a speedometer measures the distance travelled.

*8. Make up and solve a problem about the speedometer readings of an automobile and the consumption of gasoline.

### FINDING DIFFICULTIES IN MULTIPLYING DECIMALS

Multiplying by decimals is easy if your computations are correct and if you know how to apply the following rule:

*After multiplying one decimal by another, point off as many decimal places in the product as there are decimal places in the numbers being multiplied. Count from the right.*

Apply this rule to the examples below:

| *a.* | *b.* | *c.* | *d.* |
|---|---|---|---|
| 4.9 | $3.75 | .148 | 364 |
| .5 | 6 | .3 | 2.1 |
| 2.45 | $22.50 | .0444 | 364 |
| | | | 728 |
| | | | 764.4 |

The products in the following examples are correct, except for the placing of the decimal points. Copy each answer and insert the decimal points:

1. $.3 \times 4.1 = 1\,2\,3$
2. $.7 \times 25 = 1\,7\,5$
3. $.12 \times 25.7 = 3\,0\,8\,4$
4. $.08 \times 8.74 = 6\,9\,9\,2$
5. $4 \times 5.2 = 2\,0\,8$
6. $.3 \times 2.64 = 7\,9\,2$
7. $.3 \times .25 = 7\,5$
8. $15 \times 6.57 = 9\,8.5\,5$
9. $4 \times .26 = 1\,0\,4$
10. $.05 \times 58.4 = 2\,9\,2\,0$
11. $.04 \times .573 = 2\,2\,9\,2$
12. $.74 \times 25.6 = 1\,8\,9\,4\,4$
13. $.5 \times .47 = 2\,3\,5$
14. $.9 \times 26.04 = 2\,3\,4\,3\,6$
15. $94 \times 6.25 = 5\,8\,7\,5\,0$
16. $.4 \times 2.1 = 8\,4$

17. How much does it cost to travel 300 miles by rail if the fare is 3.6 cents or $.036 a mile?

18. On an automobile trip John's father purchased 10 gallons of gasoline at 18.2 cents a gallon. How much did he pay for the gasoline?

19. Select the correct answer for each of the following:

*a.* $.5 \times .24 =$ 12, 1.2, or .12

*b.* $2.5 \times 50 =$ 1.25, 12.5, or 125

### A USEFUL CHECK IN MULTIPLYING DECIMALS

This exercise explains an easy way of checking the pointing off of decimal places in the multiplication of decimals.

**1.** Does $6.2 \times 3.4$ equal 21.08, 2.108, or 210.8?

An easy way to avoid errors in placing the decimal point is to work as follows:

*Think:* 6.2 is more than 6 and less than 7.
3.4 is more than 3 and less than 4.
The product of 6.2 and 3.4 is therefore more than $6 \times 3$ or 18 and less than $7 \times 4$ or 28. Therefore 21.08 must be about the correct answer, since 21.08 is between 18 and 28. It is more nearly correct than either of the other numbers.

In each of the following select the number that you think is the correct product or nearest the correct product.

**2.** $2.5 \times 2.5 =$ 62.5, 6.25, or .625
**3.** $1.2 \times 1.2 =$ 14.4, .144, or 1.44
**4.** $1.3 \times 1.3 =$ 1.69. 16.9, or .169
**5.** $2.4 \times 1.75 =$ 420, 4.2, or .42
**6.** $.5 \times 4.8 =$ 2.4, .24, or 24
**7.** $.09 \times 4.6 =$ .414, 4.14, or 41.4
**8.** $12.3 \times 1.1 =$ 135.3, 1.353, or 13.53
**9.** $.15 \times .8 =$ 12, .012, or .12
**10.** $12.8 \times 1.75 =$ 2.24, 224, .224, or 22.4
**11.** $3.5 \times 2.1 =$ 73.5, .735, or 7.35
**12.** $3.3 \times .03 =$ .099, 9.9, or 99
**13.** $2.9 \times 2.2 =$ 638, 6.38, or 63.8
**14.** $2.33 \times .3 =$ .699, 69.9, or 6.99
**15.** $26 \times .06 =$ .156, 1.56, or 15.6
**16.** $4.8 \times 1.3 =$ 6.24, 62.4, or .624
**17.** $1.5 \times 1.5 =$ 2.25, 22.5, or .225
**18.** $.12 \times 15 =$ .18, 1.8, or .018

**PRACTICE EXERCISES IN MULTIPLICATION OF DECIMALS**

Practise the examples in each set until you can work all of them correctly. Watch the decimal points.

**Set I**

| | *a* | *b* | *c* |
|---|---|---|---|
| 1. | $3 \times .3 =$ | $6 \times .1 =$ | $2 \times .2 =$ |
| 2. | $4 \times .01 =$ | $2 \times .03 =$ | $7 \times .09 =$ |
| 3. | $6 \times .001 =$ | $4 \times .002 =$ | $8 \times .004 =$ |
| 4. | $6 \times .5 =$ | $5 \times .04 =$ | $8 \times .005 =$ |
| 5. | $7 \times 5.6 =$ | $6 \times 3.9 =$ | $8 \times 8.5 =$ |
| 6. | $4 \times 5.87 =$ | $9 \times 6.54 =$ | $6 \times 7.943 =$ |
| 7. | $24 \times 9.5 =$ | $.9 \times 70 =$ | $.8 \times 27 =$ |
| 8. | $8 \times .7 =$ | $9 \times .02 =$ | $6 \times .007 =$ |

**Set II**

| | | | |
|---|---|---|---|
| 1. | $.4 \times .2 =$ | $.4 \times .7 =$ | $.6 \times .7 =$ |
| 2. | $.5 \times .01 =$ | $.9 \times .04 =$ | $.8 \times .06 =$ |
| 3. | $.6 \times .75 =$ | $.8 \times .25 =$ | $.4 \times .65 =$ |
| 4. | $.5 \times .375 =$ | $.4 \times .693 =$ | $.9 \times .843 =$ |
| 5. | $.3 \times 1.4 =$ | $.2 \times 2.7 =$ | $.4 \times 5.6 =$ |
| 6. | $3.4 \times 6.7 =$ | $1.8 \times 2.9 =$ | $3.1 \times 4.8 =$ |
| 7. | $.58 \times 16.9 =$ | $.73 \times 28.4 =$ | $2.3 \times 1.49 =$ |
| 8. | $.7 \times .7 =$ | $.8 \times .06 =$ | $.8 \times .75 =$ |

**Set III**

| | | | |
|---|---|---|---|
| 1. | $.4 \times .25 =$ | $.3 \times .2 =$ | $.4 \times .06 =$ |
| 2. | $.07 \times 2.93 =$ | $5 \times 3.2 =$ | $4.8 \times 3.6 =$ |
| 3. | $.7 \times .08 =$ | $6.5 \times 1.5 =$ | $.07 \times 8.09 =$ |
| 4. | $19 \times 6.87 =$ | $4.9 \times 1.6 =$ | $8.1 \times 4.5 =$ |
| 5. | $8 \times 4.6 =$ | $.7 \times 3 =$ | $.5 \times .1 =$ |
| 6. | $7.2 \times 9.5 =$ | $7.3 \times 6.3 =$ | $.05 \times 1.34 =$ |
| 7. | $.5 \times .617 =$ | $.4 \times 15 =$ | $.15 \times .09 =$ |
| 8. | $.2 \times .75 =$ | $.81 \times 7.18 =$ | $.6 \times .01 =$ |

### USING FRACTIONAL PARTS OF A DOLLAR

John's brother, Harry, who worked in the bank, showed him some quick ways of multiplying amounts of money. He began by showing John how to multiply 25 cents by 48. He said, "48 × 25¢ is the same as 48 × $\$\frac{1}{4}$, since 25 cents is $\frac{1}{4}$ of a dollar." Show that Harry was correct.

**1.** What part of a dollar is 10 cents? 50 cents?

**2.** Harry showed John how to make a list of the most common fractional parts of a dollar which he could use in multiplying. Here is part of John's table. Complete it.

| Cents..... | 50 | 25 | 75 | $12\frac{1}{2}$ | $37\frac{1}{2}$ | 20 | $16\frac{2}{3}$ | $33\frac{1}{3}$ |
|---|---|---|---|---|---|---|---|---|
| Fraction of $1.00. | $\frac{1}{2}$ | | | | | | | |

**3.** Find the cost of 24 yards of ribbon at $37\frac{1}{2}$¢ a yard.

*Think:* $24 \times 37\frac{1}{2}¢ = 24 \times \$\frac{3}{8} = ?$

**4.** Harry was paid $16\frac{2}{3}$¢ an hour as clerk at the grocery store. He worked 36 hours. How much did he earn?

*Think:* $36 \times 16\frac{2}{3}¢ = 36 \times \$— = \$—$

**5.** Find the cost of 8 yards of broadcloth at $\$1.37\frac{1}{2}$ a yard.

**6.** How quickly can you give the answers to the following examples? Practise until you can work six examples like these in one minute. Find the cost of:

| | | |
|---|---|---|
| *a.* 68 ft. at 25¢ | *g.* 986 lb. at 50¢ | *m.* 640 lb. at 25¢ |
| *b.* 48 yd. at $12\frac{1}{2}$¢ | *h.* 32 ft. at 75¢ | *n.* 32 lb. at $37\frac{1}{2}$¢ |
| *c.* 45 lb. at 20¢ | *i.* 64 yd. at $12\frac{1}{2}$¢ | *o.* 36 yd. at 75¢ |
| *d.* 56 yd. at $37\frac{1}{2}$¢ | *j.* 484 yd. at 25¢ | *p.* 42 ft. at $16\frac{2}{3}$¢ |
| *e.* 320 lb. at $12\frac{1}{2}$¢ | *k.* 104 ft. at $37\frac{1}{2}$¢ | *q.* 639 yd. at $33\frac{1}{3}$¢ |
| *f.* 636 yd. at $33\frac{1}{3}$¢ | *l.* 144 lb. at $12\frac{1}{2}$¢ | *r.* 702 ft. at 50¢ |

### MULTIPLYING AND DIVIDING BY 10, 100, AND 1,000

Here are short cuts in multiplying and dividing by 10; 100; 1,000. They make use of the principle of *place value.*

*a.* $10 \times 75 = 750$ ..... *To multiply any whole number by 10, annex one zero.*

*b.* $100 \times 80 = 8{,}000$ ..... *To multiply any whole number by 100, annex two zeros.*

*c.* $1{,}000 \times 857 = 857{,}000$ ... *To multiply any whole number by 1,000, annex three zeros.*

*d.* $10 \times 8.61 = 86.1$ ..... *To multiply any decimal by 10, move the decimal point one place to the right.*

*e.* $100 \times 76.2 = 7{,}620$ ..... *To multiply any decimal by 100, move the decimal point two places to the right.*

*f.* $1{,}000 \times .9753 = 975.3$ ... *To multiply any decimal by 1,000, move the decimal point three places to the right.*

*g.* $648 \div 10 = 64.8$
$9.5 \div 10 = .95$ } ..... *To divide any decimal or whole number by 10, move the decimal point one place to the left.*

*h.* $976 \div 100 = 9.76$
$8.5 \div 100 = .085$ } ..... *To divide any decimal or whole number by 100, move the decimal point two places to the left.*

*i.* $650 \div 1{,}000 = .650$
$85.1 \div 1{,}000 = .0851$ } .. *To divide any decimal or whole number by 1,000, move the decimal point three places to the left.*

**1.** Multiply each of the following numbers by 10, by 100, and by 1,000.

*a.* 9; *b.* 35; *c.* 64.8; *d.* .9; *e.* 1.27; *f.* .965; *g.* 1.8.

**2.** Divide each of the above numbers by 10, by 100, and by 1,000.

**3.** A 10-pound bag of sugar costs 63¢ What is the price a pound?

**4.** If a 10-pound bag of flour costs $.56, how much will 100 pounds cost at the same rate?

**5.** Frank's father estimated that he would raise 1,400 bushels of wheat on a 100-acre field. How many bushels an acre is this?

**6.** A box contains 100 books weighing 34 pounds. If the books are all of the same weight, find the weight of each book.

**7.** It costs $3.60 to ship a box weighing 100 pounds to the city. What is the cost a pound?

**8.** The cost of travel by rail is 3.6 cents a mile. Find the cost of travelling 100 miles; 1,000 miles; 10 miles.

**9.** A certain store made a profit of $.002 a pound on sugar. Find the profit on a day's sales which amounted to 1,000 pounds.

**10.** John bought 100 Christmas cards for $.65 and sold them each at 2¢. How much did he gain on each card?

**11.** John's father finds that the cost of gasoline for travelling 100 miles is $1.18. How much is the cost a mile? for 10 miles?

**12.** Multiply 125, 12.5, 1.25, and .125 by 10, 100, and 1,000.

**13.** Divide 125, 12.5, 1.25, and .125 by 10, 100, and 1,000.

## USING SHORT CUTS IN MULTIPLICATION

**1.** How many trees are there in an orchard containing 25 rows, if there are 54 trees in a row?

There are two methods of finding $25 \times 54$.

| *Method A* | *Method B* |
|---|---|
| 54<br>25<br>270<br>108<br>1350 | 1350<br>4)5400<br>Think of 25 as $\frac{100}{4}$. To multiply 54 by $\frac{100}{4}$, multiply 54 by 100 by adding two zeros, and divide the product by 4. |

Which method is the quicker, *Method A* or *Method B?*

**2.** Is $12\frac{1}{2}$ equal to $\frac{100}{8}$? Suggest a short way of multiplying by $12\frac{1}{2}$.

Learn these short cuts in multiplication:

To multiply by 5, *multiply by 10 and divide by 2.*
To multiply by 25, *multiply by 100 and divide by 4.*
To multiply by 50, *multiply by 100 and divide by 2.*
To multiply by $12\frac{1}{2}$, *multiply by 100 and divide by 8.*
To multiply by $33\frac{1}{3}$, *multiply by 100 and divide by 3.*

Numbers such as $12\frac{1}{2}$, 25, and $33\frac{1}{3}$, which divide 100 exactly, are called *aliquot parts* of 100.

Multiply the following numbers, using the short methods:

**1.** $5 \times 46 =$
**2.** $25 \times 40 =$
**3.** $50 \times 76 =$
**4.** $5 \times 127 =$
**5.** $25 \times 148 =$
**6.** $50 \times 739 =$
**7.** $12\frac{1}{2} \times 800 =$
**8.** $16\frac{2}{3} \times 66 =$
**9.** $33\frac{1}{3} \times 48 =$
**10.** $12\frac{1}{2} \times 96 =$
**11.** $16\frac{2}{3} \times 120 =$
**12.** $97 \times 50 =$
**13.** $33\frac{1}{3} \times 84 =$
**14.** $5 \times 1{,}987 =$
**15.** $25 \times 861 =$
**16.** $39 \times 16\frac{2}{3} =$
**17.** $288 \times 33\frac{1}{3} =$
**18.** $50 \times 649 =$
**19.** $25 \times 9{,}668 =$
**20.** $496 \times 1{,}000 =$
**21.** $33\frac{1}{3} \times 891 =$

## STUDY HELPS IN THE DIVISION OF DECIMALS

Division of decimals is much like the division of whole numbers. You must be sure, however, to place the decimal point in each quotient correctly.

If the divisor is a whole number, *place the decimal point in the quotient directly over the decimal point in the dividend.* Examine these examples and show that the work is correct.

*a.* $8\overline{)2.56}$ .32 *b.* $6\overline{).96}$ .16 *c.* $9\overline{).75}$ .08$\frac{1}{3}$ *d.* $25\overline{)2.00}$ .08 *e.* $16\overline{)17.76}$ 1.11

Why was it necessary to insert zeros in the quotients of the third and fourth examples? Why were two zeros added to dividend 2 in example *d*?

If the divisor is a decimal, proceed as follows:

1. *Shift the decimal point in the divisor to the right by placing a caret* ($\wedge$) *at the end of the divisor. The shift makes the divisor a whole number.*

2. *Shift the decimal point in the dividend to the right as many places as you shifted the decimal point in the divisor. Place a caret* ($\wedge$) *in the dividend to show how far you shifted the decimal point. Use zeros to fill in empty places whenever necessary.*

3. *The decimal point in the quotient should be placed directly above the caret* ($\wedge$) *in the dividend.*

Show that the work is correct in the following examples:

*a.* $10.5 \div .7 = ?$

$$.7_{\wedge}\overline{)10.5_{\wedge}} \quad 1\,5.$$

*b.* $12.25 \div 3.5 = ?$

$$3.5_{\wedge}\overline{)12.2_{\wedge}5} \quad 3.5$$

*c.* $253.5 \div .65 = ?$

$$.65_{\wedge}\overline{)253.50_{\wedge}} \quad 3\,90.$$

*d.* $53 \div 1.5 = ?$

$$1.5_{\wedge}\overline{)53.0_{\wedge}000} \quad 3\,5.333$$

Why is it necessary to add a zero to the dividend in example *a*?

In example *d*, the work is carried to three places and there is a remainder. The remainder is less than half of 15 and is, therefore, dropped.

Copy the following examples and indicate with a caret (∧) how the decimal points should be shifted before dividing. Then work the examples.

| | | |
|---|---|---|
| **1.** $6.2\overline{)19.84}$ | **4.** $.93\overline{)30.69}$ | **7.** $7.2\overline{)1.512}$ |
| **2.** $.64\overline{)5.796}$ | **5.** $.21\overline{)196.812}$ | **8.** $.026\overline{)8.508}$ |
| **3.** $6.7\overline{)415.4}$ | **6.** $.56\overline{)226.4}$ | **9.** $7.6\overline{)185}$ |

### How to Use Zeros in Division with Decimals

*a.* $.64\overline{)409.60}$ — *Hard Spot:* Why was the 0 added to 409.6?

*b.* $.064\overline{)409.6}$ — *Hard Spot:* How many zeros must be added to 409.6 in this example?

*c.* $8.4\overline{).07056}$ — *Hard Spot:* Why is it necessary to place two zeros in the quotient?

*d.* $3.3\overline{).1089}$ — *Hard Spot:* How many zeros should be placed before 33 in the quotient?

Find the quotients of the following:

| | | |
|---|---|---|
| **1.** $7.9\overline{).06246}$ | **5.** $.67\overline{)1444.2}$ | **9.** $57.5\overline{)37.375}$ |
| **2.** $.39\overline{).01521}$ | **6.** $4.5\overline{).2025}$ | **10.** $41.7\overline{)208.5}$ |
| **3.** $48\overline{).2304}$ | **7.** $42.9\overline{)1.84041}$ | **11.** $629\overline{)43.74}$ |
| **4.** $7.3\overline{).5319}$ | **8.** $2.84\overline{).080656}$ | **12.** $4.8\overline{).1452}$ |

**13.** State a rule for pointing off decimal places in quotients.

### PRACTICE IN POINTING OFF IN QUOTIENTS

The figures in the following quotients are correct but the decimal points have not been placed. Copy the quotients and place the decimal points where they should be in the answers. Insert or add zeros as needed.

**1.** $31.2\overline{)973.44}$ = 312

**2.** $3.12\overline{)973.44}$ = 312

**3.** $.312\overline{)9.7344}$ = 312

**4.** $312\overline{)973.44}$ = 312

**5.** $.0312\overline{).97344}$ = 312

**6.** $312\overline{)97344.}$ = 312

**7.** $3.12\overline{)97344}$ = 312

**8.** $31.2\overline{)97344}$ = 312

**9.** $.312\overline{)97.344}$ = 312

**10.** $312\overline{)97.344}$ = 312

**11.** $31.2\overline{)9.7344}$ = 312

**12.** $312\overline{).97344}$ = 312

**13.** $31.2\overline{).97344}$ = 312

**14.** $.312\overline{)973.44}$ = 312

**15.** $3.12\overline{)9.7344}$ = 312

**16.** $31.2\overline{)97.344}$ = 312

**17.** $312\overline{)9.7344}$ = 312

**18.** $.312\overline{).97344}$ = 312

Prove that each of the following quotients is either correct or incorrect:

**1.** $6.4\overline{)4.48}$ = .7

**2.** $.36\overline{)1.8}$ = 5

**3.** $5.8\overline{)41.76}$ = .72

**4.** $.96\overline{)97.92}$ = 1.02

**5.** $1.25\overline{)37.625}$ = 30.1

**6.** $1.2\overline{).156}$ = .13

**7.** $16\overline{)1.92}$ = 1.2

**8.** $84\overline{)520.8}$ = 6.2

**9.** $.072\overline{)4.176}$ = 58

**10.** $.25\overline{)16}$ = .604

**11.** $.06\overline{)1.92}$ = 32

**12.** $2.5\overline{)62.5}$ = 2.5

### A USEFUL CHECK IN DIVIDING DECIMALS

One of the most difficult principles in division of decimals is the correct placing of the decimal point in the quotient.

**1.** Does $17.5 \div 2.5 = 7$, 70, or .7?

*Think:* $17.5 \div 2 = 8.75$
$17.5 \div 3 = 5.83$

Since 2.5 lies between 2 and 3, $17.5 \div 2.5$ must lie between 5.83 and 8.75. Therefore the quotient must be 7.

In each of the following, select the quotient that you think is correct. Be prepared to show why you think so.

**2.** $19.5 \div 1.5 = 13$, 1.3, or .13
**3.** $2.5 \div 1.25 = .2$, 20, or 2
**4.** $1.69 \div 1.3 = 13$, 1.3, or .13
**5.** $21.08 \div 6.2 = 34$, .34, or 3.4
**6.** $26.88 \div .96 = 2.8$, 28, or .28
**7.** $45 \div 12.5 = 3.6$, 36, or 360
**8.** $3.6 \div 24 = 15$, 1.5, 015, or .15
**9.** $268.8 \div 96 = 28$, 2.8, .28, or 280
**10.** $4.2 \div 1.75 = 24$, .24, 2.4, or .024
**11.** $45 \div 3.6 = 12.5$, 125, 1.25, or .125
**12.** $37.24 \div 4.9 = .76$, 7.6, 76, or .076

### SPECIAL PRACTICE WITH HUNDREDTHS

Find the answers to the following examples:

**1.** $.06\overline{)\$30}$
**2.** $.05\overline{)\$2.00}$
**3.** $.12\overline{)\$1.44}$
**4.** $.07\overline{)\$140}$
**5.** $.06\overline{)\$9.09}$
**6.** $.05\overline{)\$3.60}$
**7.** $.04\overline{)\$7.28}$
**8.** $.25\overline{)\$75}$
**9.** $.03\overline{)\$900}$
**10.** $.04\overline{)\$2.14}$
**11.** $.02\overline{)\$.40}$
**12.** $.06\overline{)\$.75}$
**13.** $.15\overline{)\$6.15}$
**14.** $.09\overline{)\$71.10}$
**15.** $.08\overline{)\$78.78}$



LIBRARY OF THE UNIVERSITY OF ALBERTA

### DIFFICULTIES IN DIVISION WITH DECIMALS

Work the following division examples, carrying to three places when necessary. Which examples do you find difficult? Practise the difficult types.

| | | |
|---|---|---|
| **1.** $4\overline{)4.8}$ | **11.** $8\overline{)2}$ | **21.** $.4\overline{)20}$ |
| **2.** $2\overline{).6}$ | **12.** $27\overline{)92}$ | **22.** $.8\overline{)6}$ |
| **3.** $12\overline{)6}$ | **13.** $4\overline{)16.984}$ | **23.** $.12\overline{)1.44}$ |
| **4.** $4\overline{).12}$ | **14.** $15\overline{)4.5}$ | **24.** $.11\overline{)1.441}$ |
| **5.** $20\overline{)72}$ | **15.** $25\overline{)1}$ | **25.** $.11\overline{)5.5}$ |
| **6.** $3\overline{)4.77}$ | **16.** $36\overline{)7.236}$ | **26.** $.15\overline{)3}$ |
| **7.** $4\overline{).76}$ | **17.** $.4\overline{)4.4}$ | **27.** $.16\overline{)12}$ |
| **8.** $5\overline{).875}$ | **18.** $.3\overline{)18.36}$ | **28.** $3.75\overline{)20.25}$ |
| **9.** $6\overline{).024}$ | **19.** $.5\overline{)1.5}$ | **29.** $1.25\overline{)1.375}$ |
| **10.** $12\overline{).6}$ | **20.** $.4\overline{)8}$ | **30.** $.795\overline{)182.85}$ |

**31.** Divide 47.965 by 8.92. **32.** Divide 96.473 by 84.

### HOW THE AMOUNT OF RAIN IS MEASURED

In the picture Leo is using the rain gauge in his back yard to measure the amount of rain which fell during a storm.

The amount of rainfall is expressed in inches. A reading of one inch on the rain gauge indicates that enough rain has fallen to cover the ground to a depth of one inch. Usually much less than an inch of rain falls at one

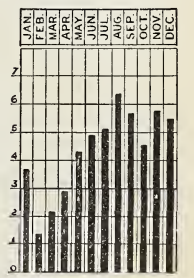
time. The measuring scale on the rain gauge, therefore, is divided into hundredths of an inch so that very small amounts of rain may be measured.

**1.** Normal rainfall for Victoria, British Columbia, is 30.6 inches a year. Find the average monthly rainfall.

**2.** Normal rainfall for Edmonton, Alberta, is 17.5 inches a year. How much less is this than for Victoria?

**3.** Valdivia, Chile, has a normal rainfall of 105.0 inches a year. How many times as much is this as the normal rainfall for Edmonton?

**4.** In 1910 Medicine Hat had only 5.43 inches of rain. In 1901 the total rainfall amounted to 28.52 inches. This is the heaviest annual rainfall on record for Medicine Hat. Find the difference. About how many times as much rain as in 1910 fell in 1901?



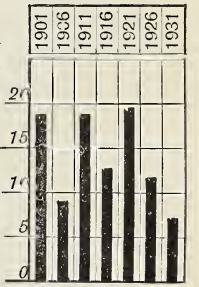
Average monthly rainfall of Porto Rico

**5.** What is the average rainfall in Porto Rico in January? Is it 3.00 inches, 3.50 inches or 4.00 inches?

**6.** List the amount of rainfall in Porto Rico for each month, correct to the nearest half inch.

**7.** Find the approximate total yearly rainfall in Porto Rico.

**8.** The bar graph at the right shows the annual rainfall in Battleford at five-year intervals between 1901 and 1931. Name the two years in which the rainfall was heaviest; was lightest.



Average annual rainfall of Battleford

## USING SHORT CUTS IN DIVISION

1. Divide 1,794 by 25.

| *Method A* | *Method B* |
|---|---|
| 71.76<br>25)1,794.00<br>175<br>44<br>25<br>190<br>175<br>150<br>150 | 1,794<br>4<br>7,176<br>7,176 ÷ 100 = 71.76<br>Think of dividing by 25 as multiplying by $\frac{1}{25}$ or by $\frac{4}{100}$. To multiply 1,794 by $\frac{4}{100}$, first multiply 1,794 by 4, then divide the product, 7,176, by 100 by moving the decimal point two places to the left. |

2. Show that dividing by 50 gives the same result as multiplying by $\frac{1}{50}$, or by $\frac{2}{100}$.

To divide by 25, *multiply by 4 and divide by 100.*
To divide by 50, *multiply by 2 and divide by 100.*
To divide by $12\frac{1}{2}$, *multiply by 8 and divide by 100.*
To divide by $16\frac{2}{3}$, *multiply by 6 and divide by 100.*
To divide by $33\frac{1}{3}$, *multiply by 3 and divide by 100.*

Divide, using the short methods:

| | | |
|---|---|---|
| **3.** 420 ÷ 25 = | **8.** 640 ÷ $12\frac{1}{2}$ = | **13.** 700 ÷ $33\frac{1}{3}$ = |
| **4.** 160 ÷ 50 = | **9.** 96 ÷ $33\frac{1}{3}$ = | **14.** 300 ÷ $16\frac{2}{3}$ = |
| **5.** 648 ÷ 25 = | **10.** 170 ÷ 25 = | **15.** 486 ÷ $16\frac{2}{3}$ = |
| **6.** 746 ÷ 50 = | **11.** 8,080 ÷ 50 = | **16.** 981 ÷ 25 = |
| **7.** 400 ÷ $12\frac{1}{2}$ = | **12.** 5,094 ÷ 25 = | **17.** 1,647 ÷ 50 = |

Find the difference in the time required to work the following examples, first by short-cut methods and again by long methods.

| | | |
|---|---|---|
| **18.** 25 × 76 = | **22.** 7,164 ÷ $16\frac{2}{3}$ = | **26.** 872 ÷ $12\frac{1}{2}$ = |
| **19.** 846 ÷ $33\frac{1}{3}$ = | **23.** $33\frac{1}{3}$ × 93 = | **27.** $16\frac{2}{3}$ × 1,284 = |
| **20.** $12\frac{1}{2}$ × 65 = | **24.** 1,964 ÷ 50 = | **28.** 279 × 50 = |
| **21.** 874 ÷ 25 = | **25.** 50 × 479 = | **29.** 25 × 498 = |

### USING SHORT CUTS IN SOLVING PROBLEMS

Use short-cut methods in solving the following problems:

**1.** Find the cost of 25 yards of cloth at \$1.24 a yard.

**2.** How many yards of cloth at $37\frac{1}{2}$ cents a yard can you buy for \$6.00?

**3.** Mr. Smith, the grocer, pays $33\frac{1}{3}$ cents a dozen for eggs. How much does he pay for 69 dozen?

**4.** Explain two ways of multiplying 75 by 40.

**5.** A labourer is paid \$.65 an hour. How much does he receive if he works 50 hours?

**6.** A horse dealer sold 75 horses for \$75 a head. How much did he receive for the horses?

**7.** How many hundredweight of milk are there in a shipment weighing 675 pounds?

**8.** At the school fair, \$47.50 was received from the sale of tickets. If the tickets cost \$.25 each, how many tickets were sold?

**9.** How long would it take an airship to fly 2,000 miles at an average speed of $66\frac{2}{3}$ miles an hour?

**10.** Mrs. Smith needs $12\frac{1}{2}$ yards of cloth for new curtains. How much will the cloth cost at \$.64 a yard?

**11.** A train travels at an average rate of $33\frac{1}{3}$ miles an hour. At this rate, how far will the train travel in 15 hours?

**12.** How much will a farmer receive for a shipment of milk weighing 800 pounds, if he is paid \$2.50 a hundred pounds?

**13.** Multiply \$60 by $6\frac{1}{4}$, $8\frac{1}{3}$, $12\frac{1}{2}$, $16\frac{2}{3}$, 25, $37\frac{1}{2}$, 50, $62\frac{1}{2}$.

***14.** Make up and solve several problems using short cuts.

### PRACTICE TEST IN FRACTIONS—NUMBER II

How many of these examples can you work correctly on your first trial in *five minutes?*

1. $\frac{7}{8} - \frac{2}{3} =$
2. $\frac{3}{4} + \frac{5}{6} =$
3. $12 \div \frac{3}{4} =$
4. $3 \times \frac{8}{9} =$
5. $3\frac{1}{2} \times 4 =$
6. $6 - 2\frac{3}{4} =$
7. $\frac{1}{3} + 8\frac{3}{4} =$
8. $\frac{7}{8} \div \frac{11}{12} =$
9. $9\frac{1}{3} - \frac{5}{6} =$
10. $3\frac{3}{8} + 4\frac{2}{3} =$
11. $5\frac{5}{8} \times 9\frac{3}{5} =$
12. $\frac{6}{7} \div 5\frac{1}{7} =$

Was your score on Test II better than your first score on Test I (page 33)? Practise this exercise until you can work the examples correctly in *less than five minutes.*

### PRACTICE TEST IN DECIMALS—NUMBER I

You should be able to work all of these examples correctly in *five minutes.*

1. $3.6 + 4.8 + 9.9 =$
2. $9.27 + 8.63 + 5.92 =$
3. $17.97 + 9.8 + 6.475 =$
4. $95.2 - 24.1 =$
5. $64.282 - 32.194 =$
6. $35.2 - 14.732 =$
7. $7.5 \times .4 =$
8. $8 \times .56 =$
9. $.04 \times 56.3 =$
10. $7.32 \div 4 =$
11. $3.735 \div .9 =$
12. $76.824 \div .012 =$
13. Change $\frac{7}{8}$ to a decimal fraction.
14. Change 6.75 to a mixed number.

Make a record of your time, and of the number of examples you have correct in three trials of this exercise.

### SPECIAL PRACTICE WITH HUNDREDTHS

Express the following fractions as decimals correct to hundredths. Express the remainders as fractions:

1. $\frac{1}{2}, \frac{1}{4}, \frac{3}{4}$
2. $\frac{1}{3}, \frac{2}{3}, \frac{1}{6}$
3. $\frac{17}{20}, \frac{8}{15}, \frac{8}{25}$
4. $\frac{1}{5}, \frac{2}{5}, \frac{3}{5}$
5. $\frac{5}{6}, \frac{5}{8}, \frac{9}{15}$
6. $\frac{1}{12}, \frac{8}{9}, \frac{9}{15}$
7. $\frac{1}{8}, \frac{3}{8}, \frac{7}{8}$
8. $\frac{1}{9}, \frac{7}{20}, \frac{19}{25}$
9. $\frac{5}{20}, \frac{1}{20}, \frac{3}{50}$

## PROBLEM SCALE I

**1.** Potatoes are priced at 80 cents a bushel, or 25 cents a peck. How much is saved by buying a bushel of potatoes by the bushel instead of by the peck?

**2.** Frank bought a dozen packages of firecrackers for 40 cents. He sold 8 packages at 5 cents each, and the remainder at 4 cents each. How much did he gain?

**3.** The Chase Flour Mills have an output of 3,000 barrels a day (196 pounds to a barrel). How many 49-pound sacks can be filled from one day's output?

**4.** How many 8-inch badges can be cut from a piece of ribbon $1\frac{1}{3}$ yards long?

**5.** Susan Miller made an automobile trip of 135 miles in 4 hours 30 minutes. What was the average number of miles an hour she travelled?

**6.** Mr. Slemmer rented a two-car garage at $8.00 a month. He sublet space for one car at $6.00 a month. How much rent did Mr. Slemmer pay a year for his own car?

**7.** Find the cost of 800 bricks at $22.50 a thousand.

**8.** I bought $9\frac{1}{2}$ bushels of nuts at $4.75 a bushel and sold them at $12\frac{1}{2}$ cents a pint. How much was my gross profit?

**9.** A farm agent conducted an experiment, using two fields, one of which he fertilized. The fertilized field produced 21.3 bushels an acre, and the other field produced 14.2 bushels an acre. How many times as much was produced on the fertilized field as on the unfertilized field?

**10.** How many paving blocks, 8 inches by 4 inches, will be required for a street 100 yards long and 40 feet wide? Make no allowance for waste or spacing.

## SECTION II

### PREPARING BUDGETS AND KEEPING ACCOUNTS

**John prepares his budget.** John decided at the beginning of the school year to keep a record of the amount of money he earned and spent during the year. His father showed him how to make the *budget* below.

A budget is an estimate of earnings and expenses for a year. John did not pay for his food, clothing, laundry, and similar items.

Find his estimated income, outgo, and balance.

| INCOME ESTIMATED RECEIPTS | | OUTGO ESTIMATED EXPENSES AND SAVINGS | |
|---|---|---|---|
| *Delivering papers 48 wks. @ $2.* | 96 — | *School supplies* | 10 — |
| *Cleaning sidewalk 12 wks. @ 50c.* | 6 — | *Carfare* | 15 — |
| *Mowing lawn 20 wks. @ 50c.* | 10 — | *Church* | 5 — |
| *Working as errand boy* | 3 — | *Tickets, athletic games* | 6 — |
| *Gifts* | 5 — | *Bicycle repairs* | 4 — |
| | | *Athletic supplies* | 5 — |
| | | *Movie tickets* | 3 — |
| | | *Books and magazines* | 4 — |
| | | *Boy Scouts* | 11 — |
| | | *Vacation trip* | 15 — |
| | | *Salary, substitute to deliver papers* | 5 — |
| | | *Savings* | 36 — |
| | ? | *Balance* | ? |
| | | | ? |

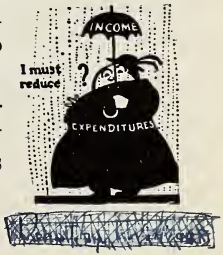
**John lives within his budget.** In order to keep within his budget and save money as he had planned, John kept an account of his actual earnings and expenses. Below is a copy of the record he kept for the month of September.

| 19— | MONEY RECEIVED | | | 19— | MONEY SPENT | | |
|---|---|---|---|---|---|---|---|
| Sept. 3 | Delivering papers | $2 | | Sept. 4 | Church | $ | 10 |
| " 3 | Mowing lawn | | 50 | " 4 | Carfare | | 14 |
| " 10 | Delivering papers | 2 | | " 8 | Ball | | 75 |
| " 10 | Mowing lawn | | 50 | " 8 | Carfare | | 14 |
| " 14 | Errand | | 25 | " 11 | Church | | 10 |
| " 17 | Delivering papers | 2 | | " 11 | Carfare | | 14 |
| " 17 | Mowing lawn | | 50 | " 13 | School supplies | 2 | 75 |
| " 23 | Distributing hand bills | | 75 | " 13 | Carfare | | 14 |
| | | | | " 17 | Show | | 20 |
| " 24 | Delivering papers | 2 | | " 17 | Carfare | | 14 |
| " 24 | Mowing lawn | | 50 | " 18 | Church | | 10 |
| | | | | " 18 | Carfare | | 14 |
| | | | | " 24 | Football game | | 50 |
| | | | | " 24 | Carfare | | 14 |
| | | | | " 25 | Church | | 10 |
| | | | | " 25 | Carfare | | 14 |
| | | | | " 28 | Book | | 75 |
| | | | | " 30 | Deposited in Savings Bank | 3 | |
| | | | | " 30 | Cash Balance | ? | |
| | | 11 | 00 | | | 11 | 00 |
| Oct. 1 | Cash Balance on Hand | ? | | | | | |

**1.** If John deposits in the savings bank each month the same amount as in September, how much more than he estimated will he have deposited at the end of the year?

**2.** Can he continue to spend as much for school supplies each month and keep within his budget allowance?

**3.** If his expenditures for car fare continue at the same rate each month, how much money may he transfer from this account to some other?




CAN A

**4.** What were his total expenses? Find the cash balance in John's account at the end of September.

**Facts to remember.** In entering your receipts and expenses in an account book, you must remember the following directions:

*a. The money you receive is entered on the left-hand side. This is called the "debit" side. Always charge or "debit" your cash account with the amount of money received.*

*b. The money you pay out is entered on the right-hand side. This is called the "credit" side. Always "credit" your cash account with the amount of money paid out.*

*c. The cash balance at the end of the month is carried forward to the debit side of the account for the next month.*

**Problems about accounts. 1.** What fraction of John's income does he plan to save? What fraction will he give to his church? What fraction of his income will his vacation trip cost?

**2.** John receives his pay for delivering papers every Saturday. During October he does not mow the lawn. He earns $.50 running errands during the month.

His expenses are as follows:

Church, $.10 each Sunday; car fare (6 round trips at 14 cents); school supplies, $.20; football game, $.50.

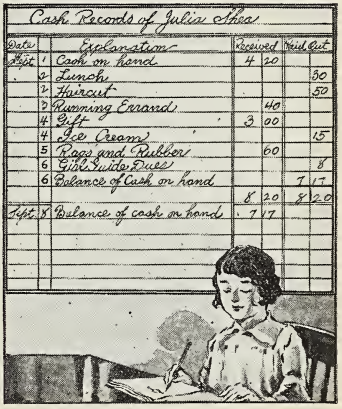
Prepare the record of his earnings, savings, and expenses which he would enter in his account book for October.

**3.** Draw up a budget of your estimated earnings and other cash receipts, together with a statement of how this money is to be used.

***4.** Prepare a budget for the Boy Scouts, Girl Guides, or some other organization to which you belong.

### MAKING ACCOUNTS BALANCE

At the end of the month John adds the *money-received* column, then he adds the *money-spent* column, and by subtracting these sums he finds how much money he should have on hand. If the results agree, his accounts *balance*. He enters his cash balance in the money-spent column as shown in the account on page 59.


Cash Records of Julia Shea

| Date | Explanation | Received | Paid Out |
|---|---|---|---|
| Sept. 1 | Cash on hand | 4 20 | |
| 2 | Lunch | | 50 |
| 2 | Haircut | | 50 |
| 3 | Running Errand | 40 | |
| 4 | Gift | 3 00 | |
| 4 | Ice Cream | | 15 |
| 5 | Rags and Rubber | 60 | |
| 6 | Girl Scout Dues | | 8 |
| 6 | Balance of Cash on hand | | 7 17 |
| | | 8 20 | 8 20 |
| Sept. 8 | Balance of cash on hand | 7 17 | |

**1.** Copy and check Julia Shea's cash record.

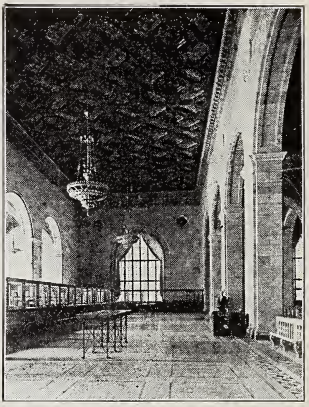
Make out a weekly account for each of the following and balance it:

**2.** *John Courtis.* Oct. 4, cash on hand, $3.68. Received: Oct. 4, $1.00, as weekly allowance; Oct. 5, $.90 for delivering groceries; Oct. 8, $5.00 from sale of old bicycle; Oct. 10, $3.20 from sale of walnuts. Spent: Oct. 5, $3.00 for football; Oct. 5, $.25 for football ticket; Oct. 6, $.15 for church; Oct. 8, $1.50 for new cap. Balance this account as of October 12.

**3.** *Fred Knight.* Dec. 16, cash on hand, $6.25. Received: Dec. 17, $.40 for cleaning walk; Dec. 8, $1.20 for clerking at grocery store; Dec. 20, $2.00 from father to buy Christmas presents; Dec. 22, $.50 for helping Mr. Jackman. Spent: Dec. 18, $2.75 for gifts; Dec. 20, $.25 for movie; Dec. 22, $.50 for sharpening skates. Balance this account as of December 24.

## THE IMPORTANCE OF BANKING

Banks play such an important part in the life of every neighborhood that all persons should have a clear idea of what a bank is and how it serves the community. Banks receive money on deposit and valuables for safekeeping. They also advise people how to save systematically and how to invest their savings securely. They lend money to responsible persons for use in their businesses or for other purposes. They perform many other services connected with the use of money and credit.



Part of the interior of a large city bank.

**Opening a savings account.** Jack had earned $4.00 and decided to put it into a *savings* bank. He went to the bank and opened *a savings account.* He filled out a *deposit slip*, like the one shown on the right, and gave it with his money to the *receiving teller*. The teller recorded the $4.00 in a *bank book* and gave it to Jack.

THE ROYAL BANK OF CANADA
SAVINGS DEPARTMENT

ACCOUNT NUMBER

19 (DATE)

CREDIT

(NAME OF ACCOUNT)

DEPOSITED BY

| | | |
|---|---|---|
| 3 X | 1 | 3 00 |
| X | 2 | |
| X | 5 | |
| X | 10 | |
| X | 20 | |
| X | 50 | |
| X | 100 | |
| GOLD | | |
| SILVER | | 1 00 |
| COPPER | | |
| | $ | |
| CHEQUES | | |
| TOTAL | $ | 4 00 |

1. What items are given on the deposit slip?

**Using a chequing account.** Jack's father, who operates an auto sales company, has a *chequing* account in the same bank. He has a *cheque book;* that is, a book of *blank cheques.* He pays all of his important bills by cheque.

*A cheque is a written order on a bank to pay a specified amount to the person named.*

Here is a copy of the cheque that Jack's father paid for his monthly garage rent.

Edmonton, Alta., May 14, 19__ No. 14

**The Royal Bank of Canada**

EDMONTON BRANCH

Pay John Kesson or Bearer $10.00

Ten and- no/100 Dollars

SAFETY DEPOSIT BOXES TO RENT

REVENUE STAMP

J. R. Adams

1. To whom is the cheque made out?

2. What is the amount of money specified? Why is the amount written in two ways?

3. What is the date of the cheque?

4. On what bank is the cheque drawn?

5. Who signed the cheque?

The word cheque is also spelt *check.*

**Indorsing cheques.** In order to cash the cheque, John Kesson must write his name on the back of the cheque, across the left end. This is called an *indorsement.*

Suppose that John Kesson wishes to cash his cheque at Mr. Jacks' grocery store. First John indorses it and

receives the cash from Mr. Jacks. Mr. Jacks also indorses the cheque before he cashes it at the bank. Of course, the bank would not cash or *cancel* the cheque if Mr. Adams did not have the specified amount of money in his chequing account.

**7.** Why is it safer to pay bills by cheque than to send money?

**8.** Do you think that a canceled cheque might serve as a receipt? Would you ask for a receipt if you paid a bill by cheque? In some places the cheque is not recognized by law as a receipt. Why?

**9.** Will a bank cash cheques drawn on any other bank?

**10.** Suppose that you have an account in the Royal Bank of Canada. Draw a cheque on that bank for $4.50, payable to John Sanderson.

**11.** Will banks cash cheques on out-of-town banks?

***12.** What is a "certified" cheque?

***13.** Select someone in the class to make a report on the "clearing house"; that is, to show what happens to a cheque sent by a person in one city to someone in another city.

***14.** Some banks use cheques printed on "safety" paper.

At the right is a kind of safety paper with lines and a design printed in a second color. If an erasure is made, the paper changes colour. Bring to class illustrations of other kinds of safety paper.

## PLANNING THE FAMILY BUDGET

Making a family budget

The government has studied the expenditures of large numbers of families with different incomes. It is suggested that the income of an average Canadian family of four persons living in a city be budgeted about as follows:

| Annual Income | Rent | Food | Clothing | Insurance and Savings | Miscellaneous |
|---|---|---|---|---|---|
| $1,500 | $375 | $600 | $180 | $75 | ? |
| 2,000 | 400 | 750 | 240 | 100 | ? |
| 2,500 | 500 | 840 | 300 | 375 | ? |
| 3,000 | 600 | 900 | 360 | 600 | ? |

**1.** Explain the meaning of each heading in the table.

**2.** Make a list of possible items included under "miscellaneous."

**3.** What fraction of each of the annual incomes is allowed for rent? for clothing? for food? for insurance and savings?

**4.** Find the amounts allowed for "miscellaneous" for each of the given incomes.

**5.** Using the facts given in the table, find the monthly amount for each item for a family with a $1,500 income.

**6.** How much more a month for food than for the $1,500 income group is the amount allowed a month for food for the $3,000 income group?

***7.** Why is it a good plan to budget the family income?

***8.** Suggest a budget for a family of four persons having an annual income of $1,000.

## BILLS AND RECEIPTS

**Why and how bills are used.** A *bill* is an itemized list of goods sold or services rendered. Below is a bill:

**Stradling, Helms & Co.**

PORTAGE AVENUE — WINNIPEG, MAN.

MRS. JOHN C. ANDREWS, — April 2, 19—

DONALD STREET,

WINNIPEG, MAN.

TERMS: On a/c — AMOUNT

Return this Coupon with Check. Retain Lower Portion of Bill. Canceled Check is Receipt. $

Bill from Stradling, Helms & Co. Paid 19 Check No.

| | 8/722 | | | | TOTAL | |
|---|---|---|---|---|---|---|
| Mar. 4 | 3½ YD. LACE | 50 | 1 | 75 | | |
| 9 | 2 HDKFS. | 25 | | 50 | | |
| | 3 PKG. LETTER PAPER | 50 | 1 | 50 | | |
| | 1 PR. SHOES | | 8 | 00 | | |
| 26 | 1 GIRL'S DRESS | | 4 | 65 | 16 | 40 |

1. What was bought March 4? What was the price a yard?

2. Check the items on the bill and the total amount Mrs. Andrews owed. The amount of each of the items is called an *extension*. Bookkeepers call the total of all extensions the *footing*.

3. Prepare a bill for the following order:

200 lb. Japan tea at 52¢ — 50 lb. Java coffee at 34¢

99 lb. Mocha coffee at 33⅓¢ — 80 lb. Young Hyson tea at 52¢

72 lb. English breakfast tea at 66⅔¢ — 140 lb. Ceylon tea at 75¢

250 lb. Maracaibo coffee at 26¢

150 lb. Rio coffee at 22½¢

*4. Be ready to give at least two reasons why people in business find it a good practice to send bills.

**Why and how receipts are used.** Here is a receipt that Mr. Andrews gave to Mr. Jones for garage rent:

$ 7.00 — Edmonton, Alta. March 1, 19—

Received of Edward S. Jones

Seven ——————— 00/100 Dollars

FOR RENT OF Garage at 33 Jasper Avenue

FOR THE MONTH ENDING February 28, 19—

Harvey S. Andrews

1. Why does Mr. Jones ask Mr. Andrews to give him a receipt for the garage rent?

2. What facts are given in the receipt that show that Mr. Andrews has received the rent? On what date was the rent paid?

3. Why is it important that Mr. Andrews' signature appear on the receipt?

4. Why is the amount of money written both with numbers and with words?

5. On August 1, Mr. E. R. Edwards paid his house rent for the month of August to P. R. Smith, the owner of the property. Prepare a receipt.

6. Mr. Peterson made a $10 payment on his grocery bill. Make out such a receipt as the grocer gave him.

7. Why is it not necessary to ask for a receipt at a grocery store when cash is paid for purchases?

## GAS IN THE HOUSEHOLD

The burning of wood and coal in the kitchen is so inconvenient that in most city homes gas is burned.

**Gas bills.** Gas companies usually send out bills every month. The following is William Sanderson's gas bill:

**NORTHWESTERN UTILITIES, Limited**

EDMONTON, ALBERTA

| Date 193— | Meter Readings | | Total Consumption | Amount | Discount | Net Amount |
|---|---|---|---|---|---|---|
| | Present | Previous | | | | |
| Jan. 18 | 8500 | 7000 | 1500 | ? | ? | ? |

William S. Anderson
135 Portage Avenue
Edmonton, Alta.

**This bill must be returned when making payment.**

SCHEDULE OF RATES

| | | | |
|---|---|---|---|
| First | 60M | feet per month | 40c |
| Next | 20M | " " " | 38c |
| Next | 20M | " " " | 33c |
| Next | 100M | " " " | 30c |
| Next | 300M | " " " | 24c |
| Next | 1000M | " " " | 23c |
| All over 1500M feet | | " | 18c |

Minimum charge $1.00 per month.
All of the above rates subject to discount of 5% if paid within date shown on stub.
No discount will be allowed on current bill unless all arrears are paid.
Failure to receive bill does not entitle consumer to discount.

Mr. Sanderson's bill was for 1,500 cu. ft. of gas. As the rate is 40¢ per thousand for the first 60 M feet, the gas used will cost $1.5 \times \$.40$, or $.60. However, as there is a minimum charge of $1.00, the amount Mr. Sanderson must pay is $1.00.

Notice that the schedule of rates shows the cost of gas to be less when greater quantities are used. Why?

Gas is usually sold by the thousand (M) cubic feet. The figures on the bill show the number of *thousands* of cubic feet used.

**1.** What is the amount of gas consumed in each of the following cases:

| | *First Reading* | *Second Reading* |
|---|---|---|
| *a.* | 2900 | 3750 |
| *b.* | 3750 | 4275 |
| *c.* | 5100 | 8550 |

**How the consumption of gas is measured.** The instrument for measuring gas is called a *gas meter*, as it records the number of cubic feet of gas which pass through it.

There are three dials on the front of a gas meter. The hands on the dials on the right and left move in the same direction as the hands on a clock. The hand on the middle dial moves in the opposite direction. In reading these dials the lower number should always be taken. Since the left-hand dial has not quite reached 8, we read 7. The hand of the middle dial is nearer 9 than 0. This means that it has made almost one complete revolution and should be read as 9. The

right-hand dial is nearer 5 than 6. The number of cubic feet represented, then, is as follows:

| | CU. FT. |
|---|---|
| First dial | 70,000 |
| Second dial | 9,000 |
| Third dial | 500 |
| Total | 79,500 |

### EXERCISES

**1.** Using the scale of prices on page 68, what is the net cost of 6,500 cubic feet of gas?

**2.** The gas-meter readings for a six-month period are:

| | | | |
|---|---|---|---|
| January 1 | 0 cu. ft. | April 1 | 7,000 cu. ft. |
| February 1 | 2,300 cu. ft. | May 1 | 9,700 cu. ft. |
| March 1 | 4,200 cu. ft. | June 1 | 10,900 cu. ft. |
| | | July 1 | 13,300 cu. ft. |

How much gas is consumed each month? Using the rates on Mr. Sanderson's bill, find the amount of the bill to be rendered each month by the gas company.

**3.** An oven consumes 30 cubic feet of gas an hour. It requires 2 hours to roast a chicken. What is the cost of the gas consumed at $1.30 a thousand cubic feet?

**4.** In January the gas bill was $2.60. On February 1 a gas heater was installed. The gas bill increased to $3.10. If the amount of gas used for other purposes remained the same, what was the amount of gas used in the gas heater at $1.20 a thousand cubic feet?

**5.** Draw three sets of dials of a gas meter. Place the hands to read the following amounts: 16,800 cubic feet; 22,600 cubic feet; 58,900 cubic feet.

## ELECTRICITY IN THE HOUSEHOLD

**How electric current is measured.** The instrument used in measuring electric current has dials very much like those on a gas meter, but current is measured, not in cubic feet, but in *kilowatt hours*. A *kilowatt hour* is the amount of electrical energy necessary to run ten 100-watt electric lamps for one hour.

Above are shown the dials of an electric meter. The hands on the dials move just as they do on the gas meter. Reading from the left-hand side the dials represent thousands, hundreds, tens, and units of kilowatt hours, abbreviated *kw. h.* The dials are read as in this table.

If you have an electric meter at home, read the dials and bring a record of the reading to class.

| | Kilowatt Hours |
|---|---|
| First dial..... | 0,000 |
| Second dial.... | 500 |
| Third dial..... | 30 |
| Fourth dial.... | 8 |
| Total..... | ? |

**Cost of electric current.** A copy of the March bill for electricity for the Wm. J. Morton family is given below.

**1.** Study the bill carefully. Be ready to explain each item on it. You can see that the same rate is not charged for all of the electricity that is used. The rates in Mr. Morton's city for electricity for a six-room house are:

The first 18 kw. h. costs 10¢ a kw. h.

The next 18 kw. h. costs $7\frac{1}{2}$¢ a kw. h.

Anything over this amount is at the rate of 3¢ a kw. h.

Some cities have a rate that is the same for any quantity that is used. Others have a minimum rate.

TO MUNICIPAL GAS & ELECTRIC CO., DR.

SERVICE FOR PERIOD SHOWN BELOW

| OFFICE | TELEPHONE | OFFICE HOURS |
|---|---|---|
| 15 Fifth Street | Main 6100 | 8:30 a.m. to 5:30 p.m. |

| Reading Dates | Meter Readings | | Difference | KWH @ 10 Cents | KWH @ 7½ Cents | KWH @ 3 Cents | Gross Bill | 5% Cash Discount | Net Bill |
|---|---|---|---|---|---|---|---|---|---|
| | Present | Previous | | | | | | | |
| Apr. 2 Mar. 2 | 764 | 722 | 42 | 1.80 | 1.35 | .18 | 3.23 | 16 | 3.07 |

MR. WM. J. MORTON,
———, Alberta

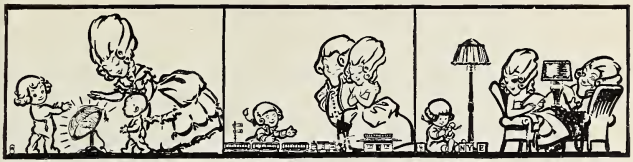
Amount Unpaid When This Bill Was Issued _____

Merchandise - - _____

Cash Discount Allowed if this bill is paid at the office of the Company on or before Apr. 20

Amount Due If Paid Within Discount Period 3 07

**2.** The readings on a new electric meter for five months were as given on page 73.



| | | | |
|---|---|---|---|
| January 1.. | 000 kw. h. | April 1..... | 105 kw. h. |
| February 1. | 35 kw. h. | May 1..... | 135 kw. h. |
| March 1... | 78 kw. h. | June 1..... | 168 kw. h. |

If the rate is 7¢ per kw. h., what is the amount of the bill for each month?

*3. Check your last month's electric bill.

*4. On the electric bulbs in your home or schoolroom, you will find the number of watts of electricity each bulb consumes an hour. Find the cost of lighting the schoolroom or your entire house for five hours, using your local electric rates to compute the cost.

The table gives the number of kilowatts an hour used by electrical appliances.

| | Kilowatt Hours |
|---|---|
| Flatiron..... | .5 |
| Vacuum cleaner.... | .135 |
| Washing machine... | .2 |
| Electric toaster..... | .55 |

5. How much more electricity is used an hour by a flatiron than by a vacuum cleaner?

6. How much less electricity is used an hour by a washing machine than by an electric toaster?

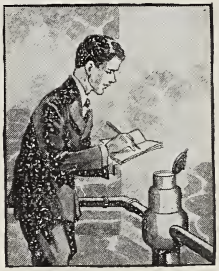
7. At ten cents a kw. h., how much would it cost to do an ironing which takes 5 hours?

8. A washing machine runs for 6 hours in doing the family washing. What is the cost at ten cents a kw. h.?

9. An electric toaster is used one half hour a day during January. What is the cost of electricity used at 8¢ a kw. h.?

### MEASURING THE WATER WE USE

Is water in your home furnished by the city or by a private company? Does your father pay a *flat rate* (a certain amount regardless of how much water is used) or does he pay a *meter rate?* If he pays a *meter rate*, you will find in your cellar a water meter which measures the number of cubic feet of water used.



Reading a water meter

**1.** Read the meter to see how many cubic feet of water have been used since the meter started at 0.

**2.** If the dial reads 16,000 on January 1, and 27,000 on April 1, how many cubic feet of water were used?

**3.** In some cities the rate for water is a certain price a thousand gallons. It is necessary to change cubic feet to gallons in order to fix the charge for water. How many gallons are there in 2,000 cubic feet of water? (*Use* $6\frac{1}{4}$ *gal.* = *1 cu. ft.*).

**4.** In a certain dwelling the meter readings for a six months' period are as follows:

| | | | |
|---|---|---|---|
| January 1 . . | 10,000 cu. ft. | April 1. . . . . | 20,200 cu. ft. |
| February 1 . | 13,600 cu. ft. | May 1. . . . . | 24,100 cu. ft. |
| March 1. . . . | 16,700 cu. ft. | June 1. . . . . | 27,300 cu. ft. |
| | | July 1. . . . . | 30,500 cu. ft. |

How many cubic feet of water were used each month for this six months' period? The rate is 25¢ a thousand gallons. What is the cost of water to this consumer for the six months' period?

**5.** Which is better for this consumer, a flat rate of $8.00 a month or the rate given in problem **4**?

### VOCABULARY REVIEW

Define the following:

1. estimate
2. round numbers
3. receipt
4. bill
5. kilowatt
6. area
7. volume
8. decimal
9. graph
10. budget
11. kilowatt
12. account
13. footing
14. debit
15. credit
16. balance

### PRACTICE TEST IN FRACTIONS—NUMBER III

You should be able to work all of these examples correctly in less than five minutes. Do not be satisfied until you can do so. If you need help, turn to Section I.

1. $\frac{3}{4} \times \frac{8}{9} =$
2. $\frac{5}{6} + \frac{7}{8} =$
3. $9 - 7\frac{2}{3} =$
4. $4 \times 16\frac{2}{3} =$
5. $6\frac{1}{4} + \frac{5}{6} =$
6. $28\frac{1}{4} - 16\frac{1}{2}$
7. $3\frac{1}{3} \div 1\frac{1}{9} =$
8. $6\frac{2}{3} \times 3\frac{3}{5} =$
9. $8 \div \frac{4}{5} =$
10. $9\frac{3}{4} + 2\frac{1}{8}$
11. $16\frac{2}{3} - 3\frac{3}{4}$
12. $7\frac{1}{2} \div 3 =$

### PRACTICE TEST IN DECIMALS—NUMBER II

You should be able to work all of these examples in less than five minutes. Check your work.

1. $8.4 + 6.5 + 7.3 =$
2. $7.25 + 8.1 + 16.725 =$
3. $8.0 + .175 + 16.48 =$
4. $87.4 - 25.8 =$
5. $39.875 - 24.5 =$
6. $67.3 - 48.75 =$
7. $7 \times .14 =$
8. $4.8 \times 1.64 =$
9. $3.75 \times 16.4 =$
10. $6.75 \div 25 =$
11. $91.65 \div 1.5 =$
12. $36 \div 1.8 =$
13. Change $\frac{7}{8}$ to a decimal fraction; .125 to a fraction.

**The bank in which John (see problem 5) has his earnings.**

## SECTION III

### HOW PER CENT IS USED

When the mathematics class began the study of percentage, Miss George asked the pupils to give illustrations of the use of the phrase *per cent.* Here are some of the uses that were given. Add other illustrations.

**1.** Arthur said, "On my last test in arithmetic I had 95 per cent of the examples correct."

**2.** Margaret said, "My per cent of attendance last month was 95."

**3.** Julia said, "The report of our marks for last month shows that 25 per cent of the class were marked *A*."

**4.** One of the pupils said that certain articles at a sale were sold at a reduction of 20 per cent.

**5.** John said that the bank in

which he had his savings account paid $2\frac{1}{2}$ per cent interest on deposits.

**6.** Helen showed that the phrase *per cent* is usually expressed by the symbol %.

**7.** Some of the pupils reported that business houses often give a small per cent of discount for cash payment.

**8.** Illustrations of the uses of per cent in textbooks and reference books were reported by some of the pupils.

**9.** Shirley explained that *per cent* is used by business men instead of the word *hundredths*.

### The Meaning of Per Cent

*Per cent* means "by the *hundred*." The expression .65, or $\frac{65}{100}$, may also be written as 65 per cent or 65%. Any fraction or decimal that is expressed as hundredths may be written as a per cent.

$\frac{7}{100} = .07 = 7$ per cent $= 7\%$.
$\frac{37}{100} = .37 = 37$ per cent $= 37\%$.

**1.** Express the following as per cents:

.35; .27; .46; .06; .02; .20; .30; $\frac{11}{100}$; $\frac{33}{100}$.

**2.** Express the following as decimals and as fractions:

45%; 35%; 60%; 40%; 27%; 15%; 5%; 7%.

**3.** Is 3% equal to .3300, or .03?

**4.** Is 45% equal to .45, 4.5, or 450?

**5.** Is 60% equal to .06, .6, or 60?

Sometimes decimals such as .125, .4, or 1.3 must be changed to per cents.

**6.** Change .125, .4, and 1.3 to per cents.

.125 = 12.5% = 12½%; .4 = .40 = 40%; 1.3 = 1.30 = 130%.

*To change a decimal to per cent, move the decimal point two places to the right and add %, the per cent sign.* Apply this rule to the numbers in exercise **6.**

**7.** Change the following to per cents:

.375; .6; .04; 1.4; 1.25; .16; .3; 2.7; .045; .625; .005.

**8.** Change 3%, 12.5%, 37½%, and 145% to decimals.

3% = .03; 12.5% = .125; 37½% = .37½ or .375; 145% = 1.45.

*To change per cents to decimals drop the per cent sign and move the decimal point two places to the left.* Apply this rule to the numbers in exercise **8.**

**9.** Change the following per cents to decimals:

45%; 37.5%; 62½%; 4%; 20%; 3.5%; 4½%; 125%; ½%.

**10.** Sarah had 85% of the words in a spelling test correct. Write this sentence, using a decimal; using a common fraction.

**11.** Out of 100 examples in a practice lesson, Harry worked 97 correctly. Write this sentence, using a common fraction; using a decimal; using per cent.

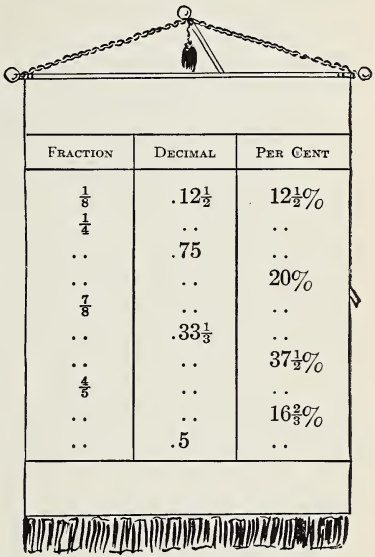
**12.** Harry saves 10 per cent of his allowance. Write this sentence, using a decimal; using a common fraction.

**13.** How many pupils in your class are present today? absent? What fraction of the class is present? absent? What decimal part of your class is present? absent?

**14.** Which is more, .4 or 37%?

## RELATING FRACTIONS, DECIMALS, AND PER CENTS

Make a neat copy of the banner at the right. Find the missing numbers and fill in the empty places. Express the decimal form as hundredths.



| Fraction | Decimal | Per Cent |
|---|---|---|
| $\frac{1}{8}$ | $.12\frac{1}{2}$ | $12\frac{1}{2}\%$ |
| $\frac{1}{4}$ | .. | .. |
| .. | .75 | .. |
| .. | .. | 20% |
| $\frac{7}{8}$ | .. | .. |
| .. | $.33\frac{1}{3}$ | .. |
| .. | .. | $37\frac{1}{2}\%$ |
| $\frac{4}{5}$ | .. | .. |
| .. | .. | $16\frac{2}{3}\%$ |
| .. | .5 | .. |

Fill the blanks in the following table:

| Fraction | Decimal | Per Cent |
|---|---|---|
| $\frac{3}{8}$ | .. | .. |
| .. | .. | 50% |
| $\frac{1}{7}$ | .. | .. |
| .. | .05 | .. |
| .. | .. | 6% |
| $\frac{7}{20}$ | .. | .. |
| .. | .24 | .. |
| $\frac{3}{5}$ | .. | .. |
| .. | .. | $3\frac{1}{3}\%$ |
| $\frac{5}{9}$ | .. | .. |

Study example **1**, and then find the numbers that should be in the blanks in the other examples. Do not use pencil and paper.

**1.** 4 is $\frac{1}{4}$, .25, 25% of 16
**2.** 3 is —, —, —— of 12
**3.** 2 is —, —, —— of 10
**4.** 6 is —, —, —— of 24
**5.** 8 is —, —, —— of 16
**6.** 5 is —, —, —— of 15
**7.** 7 is —, —, —— of 21
**8.** 7 is —, —, —— of 42
**9.** 6 is —, —, —— of 8
**10.** 9 is —, —, —— of 12
**11.** 2 is —, —, —— of 16
**12.** 6 is —, —, —— of 16
**13.** 20 is —, —, —— of 100
**14.** 16 is —, —, —— of 20
**15.** 7 is —, —, —— of 56
**16.** 7 is —, —, —— of 70

### USING PER CENTS

**1.** Miss Smith reported that the attendance in her class was 100%. There were 40 pupils in the class. How many were present?

*Think:* 100% = 100 hundredths = $\frac{100}{100}$ = 1.00 = 1.
100% of 40 therefore equals 1 × 40 or 40.
100% present means all present.
100% of any number equals 1 times that number, or the number itself. 100% of anything means the whole of it.

**2.** A baseball team played 40 games and won 100% of them. How many games did the team win?

**3.** In a spelling test of 20 words, Julia had 100% correct. How many words did she spell correctly?

**4.** In an arithmetic test of 20 examples, Arthur had 20 examples correct. What per cent did he have correct?

**5.** State each of the following sentences in another way:

*a.* All pupils are present.
*b.* This coat is 100% rainproof.
*c.* This soap is 100% pure.
*d.* A sailboat sold for the same price as it cost.
*e.* All examples in a test were incorrect.

**6.** What is 100% of \$5.20? 100% of \$7.60?

**7.** If you earn \$4.50 and spend all of it for a baseball mitt, what per cent of your earnings do you spend?

**8.** Is \$.96 less than 100% of \$2.00?

**9.** In a class of 20 boys, all were Boy Scouts. What per cent of the boys belonged to the Boy Scouts?

**10.** After a 4-yard piece of cloth had been washed and dried, it was still 4 yards in length. What per cent of the original length was the length after washing?

### ADDING AND SUBTRACTING PER CENTS

Per cents may be added or subtracted just as we add or subtract other numbers.

**1.** In a spelling test Alice spelled 90% of the words correctly. What per cent did she misspell?

*Think:* All words = 100% of the words.
100% − 90% = 10%, the per cent misspelled.

**2.** In an arithmetic test John had 75% of the problems correct. What per cent of the problems were incorrect?

**3.** If $37\frac{1}{2}\%$ of the boys in a class are members of the Junior Boys' Club, what per cent are not members?

**4.** Harry bought a set of golf clubs for 25% less than the regular price. What per cent of the regular price did he pay for the set?

**5.** The price that Mr. Jackson paid for a used automobile was 75% of the regular price. What per cent less than the regular price did he pay for the automobile?

**6.** Mr. Smith increased the price of an article 25%. What per cent of the original price was the new price?

**7.** At the end of the month 15% of the class received a mark of "A" and 36% a mark of "B." What per cent of the class were marked "A" or "B"? What per cent of the class received other marks?

**8.** In a recent year 25.7% of all forest fires were caused by locomotive sparks and 18.4% by carelessness of campers. What per cent of all fires were due to these two causes? What per cent were due to other causes?

**9.** In a sixth-grade class 8% of the pupils are 10 years of age, 15% are 11 years of age, and 46% are 12 years of age. What per cent of the pupils are 10, 11, and 12 years of age? What per cent are not of these ages?

### FINDING PER CENTS OF NUMBERS

Harry was in charge of the school library. He was told by his principal to select 35% of the books to be rebound. There were 120 books in the library. To find the number of books he should send to the bindery, Harry worked as follows:

Since *per cent of* means *hundredths of*,
35% of 120 is the same as .35 × 120 = 42.00
or 42.

```
 120
 .35
6 00
36 0
42.00
```

1. The principal told Harry he would increase the number of books in the library by 15%. How many books would there be in the library then?

2. Find the number of pupils left in a class of 45 children if 20% of them go to the library.

3. Jean sold 10% of his chickens. If he had 40 chickens at first, how many were left?

4. About 4% of milk from the prize Jersey cow, Mary Lee, was butterfat. Find the weight of the butterfat in 125 pounds of her milk.

Find the following:

| | *a* | *b* | *c* |
|---|---|---|---|
| 5. | 2% of 32.50 | 7% of 40 | 12% of 500 lb. |
| 6. | 6% of 125 | 9% of 60 bu. | 18% of 625 lb. |
| 7. | 8% of 150 | 4% of 2,750 | 6% of 27.50 |
| 8. | 35% of 90 | 5% of 76 | 2% of 74 |
| 9. | 75% of 842 gal. | 25% of 720 lb. | 40% of 488 |
| 10. | 20% of 865 | 50% of 624 | 30% of 500 |
| 11. | 25% of 100 | 75% of 400 | 6% of 6,000 |
| 12. | 6% of 2,000 | 5% of 1,000 | 4% of 1,000 |

### FINDING PER CENTS OF INCREASE

At the beginning of the school year Helen's father increased by 20 per cent her monthly allowance of $7.00. How much was her new allowance?

*Think:* 20% of $7 = $1.40, the increase.
$7.00 + $1.40 = $8.40, the new allowance.

**1.** A grocer bought eggs for $.30 a dozen and sold them for 20% more than he paid for them. How much did he receive a dozen?

**2.** How much is $15 increased by $33\frac{1}{3}\%$ of itself?

**3.** $20 increased by 20% of itself equals how much?

**4.** Find the price of an automobile, now marked $1,680, if the price is increased $12\frac{1}{2}\%$.

**5.** Jack's brother receives a salary of $24 a week. His employer promises to increase it 10% after January 1. How much will his salary then be?

Find the increases and new prices of the following:

| | Price | Per Cent of Increase | Amount of Increase | New Price |
|---|---|---|---|---|
| **6.** | $6.00 | $33\frac{1}{3}\%$ | | |
| **7.** | $8.00 | 10% | | |
| **8.** | $7.50 | 20% | | |
| **9.** | $6.25 | 4% | | |
| **10.** | $125 | 15% | | |
| **11.** | $160 | $12\frac{1}{2}\%$ | | |

**12.** Five years ago a house and lot cost $4,000. Because of the growth of the town, property has increased about 20% in value. What is the present value of the house and lot?

**13.** Make up and solve several problems about per cents of increase.

### PER CENTS GREATER THAN 100%

100% means the whole thing, but per cents greater than 100% are often used. For example, 200% means twice the number or amount; 150% means $1\frac{1}{2}$ times; 300% means three times.

**1.** In the evening newspaper Helen saw this statement: "The population of our town is now 200% as much as it was in 1890." What does this statement mean?

*Think:* 200% = 200 hundredths = $\frac{200}{100}$ = 2.00 = 2.
200% of a number is therefore equal to 2 times the number.
The population of the town was 2 times as much as it was in 1890.

**2.** What is the meaning of 300% of a number? of 400%, 600%, 1,000%, or 1,200% of a number?

**3.** If the population of the town in problem **1** was 12,000 in 1890, what was the population according to the paper which Helen read?

*Think:* 200% of 12,000 = $\frac{200}{100} \times 12{,}000 = 2 \times 12{,}000 = ?$

**4.** A certain automobile factory increased its production 400%. Explain.

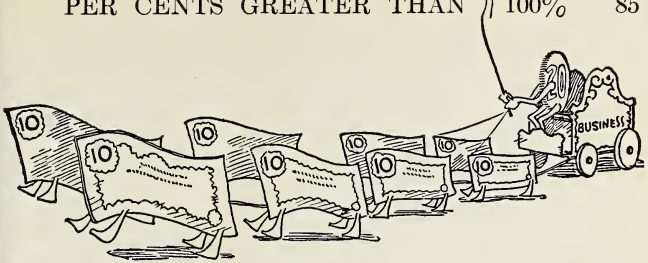
**5.** John's father weighs 3 times as much as John. State this in per cent.

**6.** In five years Harry's salary was doubled. State this fact in per cent.

**7.** State $3 \times \$50$ in per cent; $5 \times \$64$; $11 \times \$80$.

**8.** Last year Helen weighed 96 pounds. Her weight is now 115% of her weight of last year. How much does she now weigh?

*Think:* 115% of 96 lb. = ?
115% = 115 hundredths = 1.15.
115% of 96 lb. = $1.15 \times 96$ lb. = ?




**10.** If, as the cartoon above shows, for every $80 in paper bills there is $20 in gold, there is —— % as much paper money as gold money.

Express the following as decimals:

| | | | | |
|---|---|---|---|---|
| **11.** 65% | **14.** 20% | **17.** 850% | **20.** 106% | **23.** 8.5% |
| **12.** 110% | **15.** 256% | **18.** 6% | **21.** 94% | **24.** 116.5% |
| **13.** 7% | **16.** 300% | **19.** 1,000% | **22.** 7% | **25.** 17.5% |

Express the following as per cents:

| | | | | |
|---|---|---|---|---|
| **26.** .45 | **28.** 3.00 | **30.** 2.50 | **32.** 1.4 | **34.** 13.25 |
| **27.** 1.46 | **29.** .08 | **31.** 1.37 | **33.** 5. | **35.** 2.8 |

Find the answers to the following:

| | | |
|---|---|---|
| **36.** 300% of 486 | **39.** 235% of 865 | **42.** 400% of 843 |
| **37.** 540% of 650 | **40.** 150% of 728 | **43.** 120% of 764 |
| **38.** 7% of 986 | **41.** 108% of 764 | **44.** 575% of $8.96 |

## PRACTICE IN PER CENTS

### Set I

Express the following as per cents:

| | | | |
|---|---|---|---|
| **1.** .04 | **4.** 1.625 | **7.** 1.4 | **10.** .175 |
| **2.** 1.17 | **5.** .5 | **8.** $1.66\frac{2}{3}$ | **11.** 4. |
| **3.** .75 | **6.** $.37\frac{1}{2}$ | **9.** .035 | **12.** .005 |

Express the following as decimals:

| | | | |
|---|---|---|---|
| **1.** 7% | **4.** 20% | **7.** 116.4% | **10.** 300% |
| **2.** 12.5% | **5.** $\frac{1}{4}$% | **8.** 103% | **11.** $\frac{1}{2}$% |
| **3.** 18% | **6.** $33\frac{1}{3}$% | **9.** $158\frac{1}{2}$% | **12.** 3.4% |

Express the following as hundredths and as per cents:

| | | | | |
|---|---|---|---|---|
| 1. $\frac{1}{2}$ | 3. $\frac{4}{5}$ | 5. $\frac{8}{25}$ | 7. $\frac{7}{8}$ | 9. $\frac{1}{4}$ |
| 2. $\frac{1}{3}$ | 4. $\frac{7}{10}$ | 6. $\frac{1}{50}$ | 8. $\frac{5}{8}$ | 10. $\frac{5}{6}$ |

### Set II

Find the answers to the following:

| | |
|---|---|
| 1. 4% of 80 = | 12. 23% of 621 = |
| 2. 10% of 860 = | 13. $3\frac{1}{2}$% of 438 = |
| 3. 12.5% of 640 = | 14. 2.5% of 786 = |
| 4. $33\frac{1}{3}$% of 84 = | 15. 5% of 76.5 = |
| 5. 14% of 1,000 = | 16. 40% of 795 = |
| 6. $2\frac{1}{2}$% of 600 = | 17. 62.5% of 584 = |
| 7. 7.5% of 200 = | 18. $16\frac{2}{3}$% of 497 = |
| 8. 6% of 84 = | 19. 48% of 859 = |
| 9. 20% of 650 = | 20. $5\frac{1}{2}$% of 647 = |
| 10. 37.5% of 488 = | 21. 6.5% of 888 = |
| 11. $12\frac{1}{2}$% of 280 = | 22. 100% of 450 = |

### Set III

Find the answers to the following:

| | |
|---|---|
| 1. 200% of 36 = | 12. $112\frac{1}{2}$% of 800 = |
| 2. 104% of 300 = | 13. 110.3% of 600 = |
| 3. 112% of 640 = | 14. 304.5% of 700 = |
| 4. 120% of 480 = | 15. 500% of 720 = |
| 5. $133\frac{1}{3}$% of 900 = | 16. 206% of 940 = |
| 6. 119.5% of 2,000 = | 17. 146% of 859 = |
| 7. 210% of 1,000 = | 18. 150% of 87.5 = |
| 8. 300% of 482 = | 19. $162\frac{1}{2}$% of 640 = |
| 9. 107% of 865 = | 20. 104.2% of 820 = |
| 10. 137% of 900 = | 21. $264\frac{1}{2}$% of 9,000 = |
| 11. 140% of 760 = | 22. $116\frac{1}{2}$% of 3,600 = |

### HARRY LEARNS A SHORT CUT

Harry was working as clerk at a sale. Many of the articles were being sold for $12\frac{1}{2}\%$ off, $33\frac{1}{3}\%$ off, and other per cents which Harry could not figure easily. John seemed to have little difficulty with these per cents. He explained his method to Harry as follows:

"Suppose that I wish to find $12\frac{1}{2}\%$ of \$1.60. I merely take $\frac{1}{8}$ of \$1.60, which equals 20¢. $12\frac{1}{2}$, as you know, is $\frac{1}{8}$ of a hundred. $12\frac{1}{2}\%$, therefore, is $\frac{1}{8}$ of 100%."

With John's help, Harry made the following table:

| $12\frac{1}{2}\%$ | $16\frac{2}{3}\%$ | $25\%$ | $33\frac{1}{3}\%$ | $37\frac{1}{2}\%$ | $62\frac{1}{2}\%$ | $66\frac{2}{3}\%$ | $87\frac{1}{2}\%$ |
|---|---|---|---|---|---|---|---|
| $\frac{1}{8}$ | | | | | | | |

**1.** Copy and complete the table.

**2.** An article sold at $12\frac{1}{2}\%$ off costs .... less.

**3.** John bought a pair of skates at $16\frac{2}{3}\%$ off. How much of the original price did he pay?

**4.** A picture which had been marked 25% off was changed to $37\frac{1}{2}\%$ off. How much greater was the second reduction than the first?

Find the amount of reduction and the sale price:

| | Per Cent Off | Regular Price | | Per Cent Off | Regular Price |
|---|---|---|---|---|---|
| **5.** | $16\frac{2}{3}$ | \$0.30 | **13.** | $12\frac{1}{2}$ | \$0.80 |
| **6.** | $33\frac{1}{3}$ | .45 | **14.** | $33\frac{1}{3}$ | 60.00 |
| **7.** | $37\frac{1}{2}$ | .88 | **15.** | $16\frac{2}{3}$ | 75.00 |
| **8.** | $62\frac{1}{2}$ | 1.20 | **16.** | $37\frac{1}{2}$ | 1.20 |
| **9.** | $66\frac{2}{3}$ | 2.40 | **17.** | $62\frac{1}{2}$ | 3.60 |
| **10.** | $87\frac{1}{2}$ | 4.80 | **18.** | $66\frac{2}{3}$ | 4.80 |
| **11.** | $12\frac{1}{2}$ | 60.00 | **19.** | $87\frac{1}{2}$ | 13.60 |
| **12.** | 25 | 51.00 | **20.** | $33\frac{1}{3}$ | 54.00 |

### COMPARING NUMBERS BY DIVISION—RATIOS

When we say that one person earns four times as much as another, or that one number is 25% of another number, we are comparing numbers. Comparisons of numbers may be expressed in many different ways. Study the following problems carefully:

**1.** Oranges were on sale at 50¢ a dozen and apples were on sale at 25¢ a dozen. Oranges sold for how many times as much as apples?

*Think:* I am comparing 50¢ with 25¢. To compare, divide 50¢ by 25¢.

$$25\overline{)50}\quad 2$$

You can see that 50¢ is twice 25¢.

Oranges sold for twice as much as apples.

**2.** At a time when butter was selling at 48¢ a pound, lard was selling at 20¢ a pound. A pound of butter then sold for how many times as much as a pound of lard?

*Think:* I am comparing 48¢ with 20¢.

$$20\overline{)48}\quad 2\tfrac{2}{5}$$

You can see that 48¢ is $2\frac{2}{5}$ times 20¢.

**3.** In a classroom there were 40 pupils, 18 of whom were girls. What part of the class were girls?

*Think:* I am comparing 18 with 40. To find what part 18 is of 40, divide 18 by 40.

$\frac{18}{40} = \frac{9}{20}$, or expressed as a decimal, .45. The relation, .45, may be expressed as a per cent, 45%.

The relation between 18 and 40 may, therefore, be expressed in three different ways:

*a.* 18 is $\frac{9}{20}$ of 40. *b.* 18 is .45 of 40. *c.* 18 is 45% of 40.

*Ratio* is the quotient, or result, obtained when one number is divided by another of like kind.

*To compare two numbers, divide the number compared by the number with which it is compared. The result may be expressed in the following ways:*

*a.* The result may be a whole number as in problem **1.**

*b.* The result may be a mixed number as in problem **2.**

*c.* The result may be a fraction as in problem **3.**

*d.* The result may be a decimal, which may be expressed as a per cent when convenient, as in problem **3.**

**4.** Harry bought a $20 bicycle at a sale for $15. Compare the price Harry paid with the old price. Express the relation in three ways.

**5.** In May of a recent year the Giants won 24 of the 32 baseball games played. Compare the number of games won by the Giants with the number of games played. Express the relation as a fraction, as a decimal, and as a per cent.

**6.** Mr. Smith paid $2.00 a bushel for apples and sold them for $2.50 a bushel. Compare the selling price with the cost. Express the relation in three ways.

**7.** Mr. Smith bought potatoes for $1.25 a bushel and sold them for $1.50 a bushel. Compare the difference between the cost and the selling price with the cost. Express the relation in three ways.

**8.** Compare the difference between the cost and the selling price of the potatoes with the selling price. Express the relation in three ways.

**9.** A piece of woollen cloth 5 yards long was only $4\frac{1}{6}$ yards long after it had been washed. Compare the length after washing with the length before washing.

**10.** A man walks in 1 hour a distance that an automobile travels in 6 minutes. What is the ratio of their speeds?

## PRACTICE IN FINDING WHAT PER CENT ONE NUMBER IS OF ANOTHER

In much of your work in mathematics you will need to find what per cent one number is of another.

**1.** 18 is what per cent of 72?

*Think:* 18 is what fractional part of 72?
18 is $\frac{18}{72}$ of 72.
Change $\frac{18}{72}$ to hundredths by dividing 18 by 72.
$\frac{18}{72}$ = .25 or 25%.
18 = .25 of 72 = 25% of 72.

$$72\overline{)18.00}\quad .25$$
$$144$$
$$360$$
$$360$$

**2.** 15 is what per cent of 18?

*Think:* 15 is $\frac{15}{18}$ of 18.
$\frac{15}{18}$ = .83$\frac{1}{3}$ = 83$\frac{1}{3}$%.
15 = .83$\frac{1}{3}$ of 18 = 83$\frac{1}{3}$% of 18.
Does 83$\frac{1}{3}$% of 18 equal 15?

$$18\overline{)15.00}\quad .83\tfrac{1}{3}$$
$$144$$
$$60$$
$$54$$
$$6$$

**3.** 21 is what per cent of 20?

*Think:* $\frac{21}{20}$ = 1.05 = 105%.
Does 105% of 20 equal 21?

$$20\overline{)21.0}\quad 1.05$$
$$20$$
$$100$$
$$100$$

**4.** 48 is what per cent of 60?

*Think:* $\frac{48}{60}$ = .80 = 80%.
Does 80% of 60 equal 48?

$$60\overline{)48.00}\quad .80$$
$$480$$
$$0$$

**5.** 25 is what per cent of 125?

**6.** $4.50 is what per cent of $6.00?

**7.** Change $\frac{21}{25}$ to a decimal; then to a per cent.

**8.** 36 is what per cent of 96?

**9.** 4 is what per cent of 80?

**10.** 12 is—% of 36?

**11.** 15 is—% of 75?

**12.** 80 = —% of 50.
**13.** 75 = —% of 80.
**14.** 11 = —% of 44.
**15.** 16 = —% of 16.
**16.** \$4.20 = —% of \$7.
**17.** \$.30 = —% of \$.80.
**18.** 48 = —% of 30.
**19.** 75 = —% of 50.

**20.** In a spelling test of 20 words Kate spelled 19 words correctly. She marked her paper 95%. Was this correct?

**21.** Jack spelled only 15 of the 20 words correctly. What per cent of the words did he spell correctly?

**22.** A school baseball team won 16 of 20 games played. What per cent of the games played did the team win?

**23.** Of a class of 40 pupils, 6 were absent. What per cent were absent? What per cent were present?

**24.** In the sixth grade of the Earl Grey School there are 18 boys and 21 girls. What per cent of the class are boys? What per cent are girls?

**25.** 16 is what per cent of 20?

**26.** 18 is what per cent of 36?

### PRACTICE TESTS IN PER CENT

Practise these examples until you can work all of them correctly in the time allowed.

**Set I (5 minutes)**

**1.** 5 = —% of 40.
**2.** 6 = —% of 20.
**3.** 4 = —% of 100.
**4.** 12 = —% of 96.
**5.** 7.8 = —% of 30.
**6.** 125 = —% of 125.
**7.** 400 = —% of 200.
**8.** 250 = —% of 200.
**9.** 434 = —% of 910.
**10.** 1,320 = —% of 880.

**Set II (5 minutes)**

**1.** 3 = —% of 12.
**2.** 4 = —% of 10.
**3.** 3 = —% of 100.
**4.** 8 = —% of 64.
**5.** 6.4 = —% of 200.
**6.** $7\frac{1}{2}$ = —% of $22\frac{1}{2}$.
**7.** 75 = —% of 75.
**8.** 200 = —% of 100.
**9.** 135 = —% of 100.
**10.** 385 = —% of 330.

### THRIFTY BUYING

A special sale was held at Brown's grocery store. Many articles were advertised at reduced prices. Here is the upper part of the window poster:

SALE—ONE DAY ONLY

| ARTICLE | REGULAR PRICE | SALE PRICE |
|---|---|---|
| Coffee..... | 50¢ | 47¢ |
| Butter..... | 48¢ | 44¢ |
| Catsup..... | 20¢ | 19¢ |
| Raisins..... | 18¢ | 15¢ |
| 10 lb. sugar... | 68¢ | 63¢ |
| bu. potatoes.. | $1.20 | $1.05 |

**1.** The saving on a pound of coffee is — cents, or — per cent of the regular price.

**2.** The saving on a pound of butter is — cents, or — per cent.

**3.** The saving on two bottles of catsup is — cents, or — per cent.

**4.** The saving on six packages of raisins is — cents, or — per cent.

**5.** The saving on a pound of sugar is — cent, or — per cent.

**6.** The saving on a peck of potatoes is — cents, or — per cent.

*7. Make up a food problem based on the prices of the articles in similar lists.

*8. Bring to the class similar advertisements from the local papers and make up problems like these.

### FINDING A NUMBER WHEN A PER CENT OF IT IS GIVEN

**1.** Harry had 30 chickens left after he had sold 25% of his flock to a dealer. How many did he have at first?

*Think:* The number left was 75% of the original number, since he had sold 25%.
30 = 75% of ? Or, 30 = .75 × ?

$$.75\overline{)30.00}\quad 40$$

You can see that to find the original number you must divide 30 by .75.

30 ÷ .75 = 40, the original number. Check: 75% of 40 = 30.

**2.** Find the original numbers:

| | Number Remaining | % Sold | Original Number |
|---|---|---|---|
| *a.* Sheep | 60 | 25 | ? |
| *b.* Acres of land | 120 | 20 | ? |
| *c.* Cans of corn | 35 | 30 | ? |
| *d.* Pencils | 27 | 10 | ? |
| *e.* Cattle | 34 | 15 | ? |
| *f.* Pigs | 72 | 40 | ? |
| *g.* Cucumbers | 39 | 35 | ? |

**3.** Mary spelled 90% of the words in a spelling test correctly. If she spelled 18 words correctly, how many words were there in the test?

*Think:* 18 = 90% of ?

**4.** Find the number of which:

| | | |
|---|---|---|
| *a.* 20 is 40% | *e.* 30 is $33\frac{1}{3}$% | *i.* 120 is 120% |
| *b.* 30 is 25% | *f.* 15 is $16\frac{2}{3}$% | *j.* 60 is 125% |
| *c.* 10 is 10% | *g.* 14 is $87\frac{1}{2}$% | *k.* 75 is 150% |
| *d.* 40 is 8% | *h.* 20 is 12.5% | *l.* 30 is 37.5% |

## PRACTICE EXERCISES IN PER CENTS

### Set I

1. 4 = —% of 16
2. 5 = —% of 10
3. 2 = —% of 100
4. 6 = —% of 48
5. 7.6 = —% of 200
6. $4\frac{1}{2}$ = —% of $13\frac{1}{2}$
7. 5 = —% of 20
8. 10 = —% of 50
9. 12 = —% of 36
10. 7.5 = —% of 50
11. $37\frac{1}{2}$ = —% of $187\frac{1}{2}$
12. 9 = —% of 12
13. 30 = —% of 100
14. 18 = —% of 360
15. 27 = —% of 162
16. 19.2 = —% of 400

### Set II

1. 200 = —% of 100
2. 75 = —% of 75
3. 125 = —% of 100
4. 868 = —% of 910
5. 200 = —% of 1,760
6. 770 = —% of 660
7. 400 = —% of 200
8. $96\frac{1}{2}$ = —% of $96\frac{1}{2}$
9. 8,750 = —% of 7,500
10. 1,320 = —% of 5,280
11. 1,250 = —% of 1,000
12. 900 = —% of 450
13. .5 = —% of $\frac{1}{2}$
14. 450 = —% of 360
15. 9,720 = —% of 12,000
16. 3,240 = —% of 9,720

### Set III

1. 7% of — = 42
2. 20% of — = 40
3. 12.5% of — = 12
4. $33\frac{1}{3}$% of — = 17
5. 16% of — = 32
6. $3\frac{1}{2}$% of — = 7
7. 4.5% of — = 18
8. 8% of — = 16
9. 10% of — = 86
10. 12% of — = 24
11. $2\frac{1}{2}$% of — = 50
12. 2.5% of — = 75
13. 9% of — = 72
14. 30% of — = 96
15. 62.5% of — = 50
16. $66\frac{2}{3}$% of — = 800
17. 17% of — = 68
18. $4\frac{1}{2}$% of — = 900

### Set IV

1. 300% of —— = 600
2. 105% of —— = 408
3. 145% of —— = 580
4. 120% of —— = 600
5. $112\frac{1}{2}$% of —— = 324
6. 113.5% of —— = 227
7. 220% of —— = 132
8. 200% of —— = 900
9. $133\frac{1}{3}$% of —— = 540
10. 140.6% of —— = 703
11. 350% of —— = 168
12. 400% of —— = 1,200
13. 106% of —— = 636
14. 175% of —— = 700
15. 110% of —— = 1,089
16. $116\frac{2}{3}$% of —— = 1,470

## PRACTICE TESTS IN PERCENTAGE

Take these tests on successive days. Make a record of your time, and the per cent of accuracy.

### Test I

1. 5% of 200 =
2. 46% of 300 =
3. 14 = ? % of 28
4. 16 = ? % of 48
5. 9 = ? % of 360
6. 80% of 125 =
7. $1\frac{1}{2}$% of 5,000 =
8. 104% of 180 =
9. 160 = ? % of 400
10. 16% of 1,250 =

### Test II

1. 4% of 120 =
2. 9 = ? % of 180
3. 70 = ? % of 280
4. 70% of $30 =
5. ? = $\frac{1}{4}$% of 3,200
6. 18% of 250 =
7. 16 = ? % of 360
8. 1.3% of 300 =
9. 125 = ? % of 3,200
10. 450 = ? % of 200

### Test III

1. 9% of 400 =
2. 140 = ? % of 210
3. 25% of $1,000 =
4. $\frac{1}{3}$% of 480 =
5. 8% of 1,500 =
6. 100 = ? % of 160
7. 1.2% of 1,500 =
8. 10% of $400.50 =
9. 450 = ? % of 250
10. 200 = ? % of $125

### THE THREE KINDS OF PROBLEMS IN PER CENT

You have learned how to solve three kinds of problems in per cent.

**1.** In a spelling test of 25 words Alice missed 8% of the words. How many words did she misspell?

Here you are asked to find a per cent of a number. This is the *first kind of problem* in per cent. Solve the problem.

**2.** In a spelling test of 25 words Alice missed 2 words. What per cent of the words did she misspell?

Here you are asked to find what per cent one number is of another. This is the *second kind of problem* in per cent. Solve it.

**3.** In a spelling test Alice spelled 90% of the words correctly. If she spelled 45 words correctly, how many words were there in the test?

*Think:* 45 words = 90% of —— words.

Here you are asked to find the whole with a per cent of it given. This is the *third kind of problem* in per cent. Solve it.

In the following problems state what *problem* in per cent is involved in each. Then solve the problems.

**4.** Jack weighed 144 pounds. This was 120% of his normal weight. What was his normal weight?

**5.** Helen canned 20% of her crop of 75 bushels of sweet corn. How many bushels did she can?

**6.** Henri has 150 white chickens in his flock of 400 chickens. What per cent of his flock is white chickens?

**7.** A baseball team won 16 of 20 games played. What per cent of the games played did the team win?

**8.** Make up two original problems illustrating each of the three kinds of *problems* in per cent.

### EVERYDAY USES OF DECIMALS

**1.** The distance from our summer cottage to the store is 1.6 miles. How far must I walk in going to the store and back again?

**2.** On an automobile trip, Helen's father travelled 196.5 miles in 6.25 hours. How many miles an hour, on the average, did he travel?

**3.** Mr. Ash sold 75 bushels of apples for $73.50. How much per bushel did he receive?

**4.** The Panama Canal is 50.44 miles long. The Suez Canal is 102.9 miles long. Compare the lengths of these two canals by using a simple fraction.

**5.** How many pounds are there in a carload of coal containing 54.75 tons?

The Panama Canal

**6.** In a three-hour race an automobile travelled 102.25 miles the first hour, 104.30 miles the second hour, and 106.47 miles the third hour. How far did the automobile travel in the three hours? What was the average rate an hour?

**7.** When the English pound (£) is valued at $4.866, how much less than $5.00 is its value?

**8.** The total yearly rainfall in one of our cities averages 36.24 inches. What is the average monthly rainfall?

**9.** Recently a railroad train travelled 46.375 miles in 50 minutes. What was the average speed a minute?

**10.** A quart of milk weighs about 2.5 pounds, and a quart of water weighs about 2.42 pounds. Find the difference in weight.

**11.** On a 100-acre field, Mr. Nelson raised 1,264 bushels of wheat. How many bushels an acre did he raise?

**12.** If railroad fare is \$.0345 a mile, how much does it cost to make a trip of 125 miles?

**13.** Which is more .7 yard or .375 yard?

**14.** I paid \$27.60 for a ticket. Find the distance to be travelled if the fare is 3.45 cents a mile.

### DIAGNOSTIC TEST IN PER CENT

This test will help you to discover the types of examples in per cent with which you may have difficulty. Do not be satisfied until you can work all of the examples correctly. Study the previous exercises for help in difficult points.

**Part I (5 minutes)**

**1.** Express the following as per cents:

| | | | |
|---|---|---|---|
| *a.* .04 = | *d.* 1.625 = | *g.* 1.4 = | *j.* .175 = |
| *b.* 1.17 = | *e.* .5 = | *h.* $1.66\frac{2}{3}$ = | *k.* 4. = |
| *c.* .75 = | *f.* $.37\frac{1}{2}$ = | *i.* .035 = | *l.* 1.6 = |

**2.** Express the following in decimal form:

| | | | |
|---|---|---|---|
| *a.* 7% = | *d.* 20% = | *g.* 116.4% = | *j.* 300% = |
| *b.* 12.5% = | *e.* 117% = | *h.* 103% = | *k.* $2\frac{1}{2}$% = |
| *c.* 18% = | *f.* $33\frac{1}{3}$% = | *i.* $158\frac{1}{2}$% = | *l.* 3.4% = |

**3.** Express the following as hundredths and as per cents:

| | |
|---|---|
| *a.* $\frac{1}{2}$ = .50 = 50% | *d.* $\frac{3}{50}$ = — = —% |
| *b.* $\frac{1}{5}$ = — = —% | *e.* $\frac{5}{8}$ = — = —% |
| *c.* $\frac{8}{25}$ = — = —% | *f.* $\frac{5}{6}$ = — = —% |

**Part II (12 minutes)**

Find the answers to the following:

1. 4% of 80 =
2. 10% of 860 =
3. 12.5% of 640 =
4. $33\frac{1}{3}$% of 84 =
5. 14% of 1,000 =
6. $2\frac{1}{2}$% of 600 =
7. 7.5% of 200 =
8. 200% of 36 =
9. 104% of 300 =
10. 112% of 640 =
11. 120% of 480 =
12. $133\frac{1}{3}$% of 900 =
13. 119.5% of 2,000 =
14. 210% of 1,000 =

**Part III (12 minutes)**

Find the missing per cents in the following:

1. 4 = —% of 16
2. 5 = —% of 10
3. 2 = —% of 100
4. 6 = —% of 48
5. 7.6 = —% of 200
6. $4\frac{1}{2}$ = —% of $13\frac{1}{2}$
7. 85 = —% of 85
8. 300 = —% of 100
9. 125 = —% of 100
10. 868 = —% of 910
11. 2,640 = —% of 1,760
12. 770 = —% of 660

**Part IV (12 minutes)**

Find the missing numbers in the following:

1. 7% of — = 42
2. 20% of — = 200
3. 12.5% of — = 12
4. $33\frac{1}{3}$% of — = 17
5. 16% of — = 32
6. $3\frac{1}{2}$% of — = 7
7. 4.5% of — = 18
8. 300% of — = 600
9. 105% of — = 420
10. 145% of — = 580
11. 120% of — = 600
12. $112\frac{1}{2}$% of — = 405
13. 113.5% of — = 227
14. 220% of — = 132

### CUMULATIVE TEST I

If you make any mistakes on the test, practise examples like those you worked incorrectly. You should be able to complete these examples in *fifteen minutes.* Refer to the pages in italics if you have difficulty with your work.

1. $3\frac{1}{2} + 4\frac{2}{3} + 1\frac{1}{4} =$ *(20)*
2. $6\frac{1}{8} - 4\frac{1}{2} =$ *(20)*
3. $4\frac{3}{4} \times 18 =$ *(24)*
4. $9 \div 5\frac{2}{5} =$ *(29)*
5. $\frac{4}{5} \div \frac{8}{9} =$ *(29)*
6. $.3 + .7 + .9 =$ *(39)*
7. $12\frac{1}{2}\%$ of 64 = *(79)*
8. Find 87.5% of 160. *(79)*
9. $6 - 4.75 =$ *(39)*
10. $23 \times 4.68 =$ *(41)*
11. $5.1 \times 2.22 =$ *(41)*
12. $85.41 \div 9 =$ *(48)*
13. $6.725 \div .25 =$ *(48)*
14. $3.1 + 4.86 + 0.754 =$ *(39)*
15. Compare 75 and 150. *(88)*
16. 10 = ? % of 40. *(90)*
17. 20% of what number is 8? *(93)*
18. Change $\frac{7}{11}$ to a four-place decimal. *(37)*
19. Change .625 to a common fraction. *(36)*
20. Express $\frac{1}{2}\%$ as a decimal. *(79)*
21. Express 7 ft. 8 in. as feet and fraction of a foot. *(225)*
22. Divide \$45 by 60.
23. Divide 42,488 by 71. *(12)*
24. Find the product of 407 and 609. *(10)*

### PRACTICE TEST IN FRACTIONS—NUMBER IV

How many of these examples can you work correctly in *five minutes* on your first trial?

1. $\frac{2}{3} \div \frac{5}{6} =$
2. $\frac{3}{4} + \frac{6}{7} =$
3. $37\frac{3}{4} - \frac{2}{3} =$
4. $18 \times 5\frac{5}{6} =$
5. $9\frac{3}{5} \times \frac{5}{6} =$
6. $\frac{3}{4} \times \frac{8}{9} =$
7. $7 + 9\frac{4}{5} =$
8. $27\frac{2}{3} - 13\frac{7}{8} =$
9. $5\frac{3}{5} \div 7 =$
10. $\frac{4}{5} - \frac{3}{4} =$
11. $7\frac{3}{5} \div \frac{3}{4} =$
12. $4\frac{1}{6} + \frac{9}{7} =$

Was your score on Test IV better than your scores on Tests I, II, and III? Practise this exercise until you can work all of the examples correctly in *less than five minutes.*

### EVERYDAY PROBLEMS IN USING FRACTIONS

1. Mary wishes to make 4 pennants. If she needs $\frac{3}{8}$ yard of ribbon for each pennant, find the cost of the ribbon at \$.20 a yard.

2. If $7\frac{1}{2}$ bushels of seed corn will plant a 10-acre field, find the cost of seed corn an acre at \$2.20 a bushel.

3. Henry had a large bag of walnuts weighing 25 pounds, and 3 small bags weighing $3\frac{3}{4}$ pounds each. What was the total weight of the walnuts?

4. One morning Harry dug $8\frac{1}{2}$ bushels of potatoes. At noon he sold $4\frac{1}{2}$ bushels to a neighbor. In the afternoon he dug $3\frac{1}{4}$ bushels more. How many bushels did he then have?

5. Mrs. Smith divided seven $1\frac{1}{2}$-pound boxes of candy equally among four children. How much did each receive?

6. Mary practised on the piano a quarter of an hour in the morning and half an hour in the afternoon. How much less than an hour did she practise in all?

7. James raised $6\frac{1}{2}$ bushels of apples on one tree. He gave his mother $1\frac{3}{4}$ bushels and sold the rest for \$1.60 a bushel. How much did he receive for them?

8. Mr. Smith divided a $7\frac{1}{2}$-acre field into two equal parts. On one part he raised 375 bushels of potatoes. What was the average number of bushels raised on each acre? What was the value of the yield an acre at \$1.20 a bushel?

9. Mary's mother wished to make her a dress for which $3\frac{1}{2}$ yards of cloth were needed. She had bought $1\frac{1}{2}$ yards of the cloth at a sale, but had already used $\frac{3}{4}$ yard of it. How much more of the cloth must she buy for Mary's dress?

### PRACTICE TEST IN DECIMALS—NUMBER III

How many of these examples can you work correctly in *five minutes*?

1. $9.4 + 8.3 + 5.3 =$
2. $7.489 + 6.596 + 7.621 =$
3. $6.453 + 14.1 + 28.75 =$
4. $75.34 - 65.27 =$
5. $28.4 - 7.52 =$
6. $97 - 3.642 =$
7. $5 \times 3.4 =$
8. $.7 \times 9.3 =$
9. $648 \times .009 =$
10. $26.74 \div .7 =$
11. $374.5 \div .05 =$
12. $.413 \div 25 =$
13. Change $\frac{1}{16}$ to a decimal fraction.
14. Change .48 to a common fraction.

Compare your score with that made on Test II of decimals. Practise the examples until you can work all of them correctly in *less than five minutes.*

### PRACTICE TEST IN PERCENTAGE—NUMBER I

You should be able to find the answers to the following in less than *five minutes:*

1. Express the following as per cents:

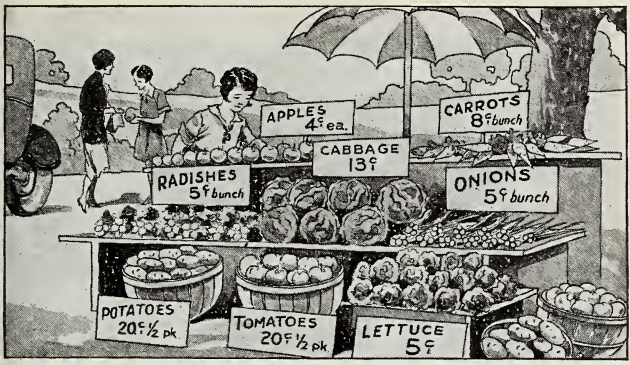
$\frac{1}{4}$ $\frac{1}{5}$ .05 1.25 .675 $1\frac{1}{3}$

2. Express the following as decimals:

15% $12\frac{1}{2}\%$ 120% 6% $\frac{1}{2}\%$ 3.5%

3. 8% of \$75 = ?
4. $12\frac{1}{2}$ = ? % of 50
5. 30 = 30% of ?
6. 120% of 200 = ?
7. 20% of ? = 15
8. 75 = ? % of 125
9. How much less than a whole is 60% of it?
10. What number is 6% less than 150?

Practise the examples in this test until you can do all of them correctly in the time allowed. How many trials of the test did you have before you reached the standard?




**Mary and Susan have a roadside market at which they sell vegetables from their father's farm.**

## *SELLING VEGETABLES

So many automobile tourists stopped at their farm to buy fruit and vegetables that Mary and Susan decided to open a vegetable stand by the roadside.

Their father agreed to furnish them vegetables at a fixed price. Some old boxes, boards, and a large umbrella were used in making the stand.

This is a list of vegetables which they purchased from their father when they started business:

| | | | |
|---|---|---|---|
| 1 bu. potatoes | $1.00 | 25 bunches of radishes @ 3¢ | $.75 |
| 25 apples @ 2¢ | .50 | 15 bunches of onions @ 3¢ | .45 |
| 1 bu. tomatoes | 1.00 | 10 heads of cabbage @ 8¢ | .80 |
| 20 heads of lettuce @ 3¢ | .60 | 10 bunches of carrots @ 5¢ | .50 |

On signs they announced the following sale prices:

| | | | |
|---|---|---|---|
| Potatoes | $0.20 a ½ pk. | Onions | $0.05 a bunch |
| Apples | .04 each | Cabbage | .13 a head |
| Lettuce | .05 a head | Carrots | .08 a bunch |
| Radishes | .05 a bunch | Tomatoes | .20 a ½ pk. |

Their sales for the first day were as follows:

| | |
|---|---|
| $3\frac{1}{2}$ pecks of potatoes | 10 bunches of onions |
| 20 apples | 7 heads of cabbage |
| 20 heads of lettuce | 10 bunches of carrots |
| 25 bunches of radishes | 4 pecks of tomatoes |

**1.** Find the cost of the vegetables purchased from their father.

**2.** The selling price less the cost is called the *gross profit*, or *margin*. How much was the margin on an apple?

*Think:* They paid 2¢ for each apple and sold it for 4¢. Hence, their margin on each apple was 4¢ less 2¢, or ——.

**3.** What was their margin on a head of lettuce? on a bunch of onions?

**4.** What was their margin on a peck of potatoes? on a peck of tomatoes?

**5.** What per cent of the cost was the margin on a $\frac{1}{2}$ peck of potatoes? on an apple? on a head of cabbage? on a peck of tomatoes?

**6.** How much did they pay their father for the vegetables they sold?

**7.** How much did they receive in all for the vegetables they sold?

**8.** How much was their margin on all of the vegetables they sold? This margin may be found by subtracting the amount they paid their father for the vegetables from the amount they received from selling them.

Besides paying their father for the vegetables, Mary and Susan had to buy bags in which to put the vegetables sold to customers, and they also had to pay for help in preparing and running the stand, just as any storekeeper has to employ clerks and incur other expenses.

The cost of running the stand that day was as follows:

| | |
|---|---|
| 100 paper bags | $0.80 |
| Hauling vegetables from garden to stand. (This they paid to their brother Tim.) | .20 |
| Helping at the stand. (This they paid to their sister Jane.) | .30 |
| Digging the potatoes and gathering the vegetables. (This they paid to their brother Tim.) | .25 |

**9.** What was the cost of running the stand for the day? This cost is called the *operating expense*, or *overhead*. The overhead subtracted from the gross profit gives the *net profit*. If the overhead was greater than the margin, the girls ran the stand *at a loss*.

**10.** What was the net profit for the day?

**11.** When gross or net profit is expressed as a per cent, it is usually based on the selling price. What per cent of gross profit did Mary and Susan make?

**12.** What per cent of net profit did Mary and Susan make?

**13.** At the end of the day Mary and Susan made a list of the vegetables that had not been sold and found the amount they owed their father for these vegetables. Such a list is called an *inventory*.

Prepare an inventory showing the vegetables Mary and Susan had on hand that night and how much they had to pay their father for them. This amount would not be counted as an expense for this day, since the vegetables were still on hand and could be sold the next day.

***14.** Make an inventory of your clothing, books, or tools. Make an estimate of the value of each item in the inventory.

## PROFIT AND LOSS

**Profits from a school fair.** At a school fair the Girl Guides sold 50 boxes of pop corn for 10¢ each. The pop corn cost them 6¢ a box.

1. What was their profit on the pop corn?

2. The profit was what per cent of the selling price? what per cent of the cost?

3. The Girl Guides sold 10 dozen apples at the rate of 3 apples for 5¢. If they paid 10¢ a dozen for them, what was the profit from the sale of apples?

4. Their profit was what per cent of the cost? what per cent of the selling price?

Many dealers believe that the rate of profit should always be computed on the selling price, while many others believe that the rate of profit should be computed on the cost. Cost usually means the cost of materials plus the expenses of selling. You can see that the Girl Guides did not have any selling expenses.

What are some of the expenses a storekeeper must meet in addition to buying the goods he sells?

A dealer's profits are sometimes reduced because some of his goods become unsalable.

There are many other conditions that may reduce his profits.

5. The club bought 8 dozen bananas for 25¢ a dozen. They sold 4 dozen at 3 bananas for 10¢, and 2 dozen (slightly spoiled) at 3 bananas for 5¢. Two dozen were entirely spoiled and were not sold. Did the club make a profit on the bananas? How much?

### PROBLEMS IN PROFIT AND LOSS

**1.** A grocer's profit on a bushel of potatoes sold at $1.20 was $.20. What was his per cent of profit?

*Think:* $.20 = ?% of $1.20.

**2.** An automobile dealer sold a car at a loss of $75. If the total cost of the car was $1,000, find the per cent of loss, based on the total cost.

Find the per cent of gain or loss on the total cost:

**3.** Suit of clothes, total cost, $30; selling price, $36.

**4.** Sewing machine, total cost, $45; selling price, $49.50.

**5.** Piano, total cost, $500; selling price, $420.

**6.** Radio set, total cost, $60; selling price, $20.

**7.** A dealer's profit in the sale of a piano was $75. If this profit was 20% of the cost, find the cost.

*Think:* $75 = 20% of ?

**8.** The loss on a bill of goods was $48. The dealer estimated that the loss was 12% of the total cost of the goods. Find the total cost.

Find the necessary items, computing per cent of gain or loss on total cost.

| | Total Cost | Selling Price | Profit or Loss | Per Cent of Profit or Loss |
|---|---|---|---|---|
| **9.** | $100 | $125 | ? | ? |
| **10.** | $250 | $225 | ? | ? |
| **11.** | $300 | ? | ? | 10% profit |
| **12.** | $400 | ? | ? | 10% loss |
| **13.** | ? | ? | $60 profit | 5% |
| **14.** | ? | ? | $40 loss | 8% |
| **15.** | $250 | $300 | ? | ? |
| **16.** | $1,000 | ? | ? | $12\frac{1}{2}$% profit |

## COMMISSION

**Meaning of commission.** The merchant in a shop sells his goods directly to his customer because the customer lives near enough to the store to deal directly with the owner of the goods. But direct selling is not always possible. A group of farmers may have a thousand bushels of apples for sale. All of them cannot be sold in the immediate neighborhood. Usually they are shipped to large cities, like Toronto, where commission merchants sell the apples.

These commission merchants receive as their pay a per cent of the sale price of the apples.

Many of you know of book agents who call at your home to sell encyclopaedias and other sets of books. These people usually receive as their pay a per cent of the sale price of the books.

The real estate agent who sells a house or a farm for your father is paid a per cent of the sale price as his *commission.* The architect who planned the schoolhouse received as his pay, or *commission,* a per cent of the cost of building the schoolhouse. Doctors and merchants often employ people to collect bills which are overdue. These collection agents receive as their commission a per cent of the amount collected. Commission is sometimes paid to the agent who buys for another.

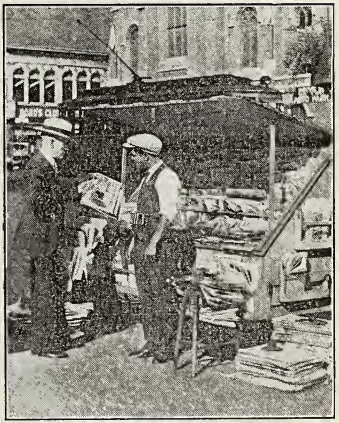
**Problems in commission.** **1.** A. girls' club wished to raise money for a summer camp. The members decided to try to secure subscriptions for a magazine. The magazine announced that for each subscription the club would be paid a commission of 25¢. The club secured 75 subscriptions. What was the total commission?

**2.** John sold toy balloons at the fair for 10¢ each. He was paid 2¢ for each sale that he made. What per cent of the selling price was paid to John?

**3.** Henry sold weekly magazines for 10¢ each. He paid $5\frac{1}{2}$¢ for each copy. Find his total profit if he sold 100 magazines and had no extra copies left.

**4.** What was his per cent of profit, based on the cost of the papers?

**5.** Daily papers were sold for 2¢ each. Henry bought them at 8 for 10¢. He sold 60 papers one evening. How much was his profit?



Henry sold papers and magazines

**6.** Jack took in $2.40 for papers. He paid the agent $1.80 for the papers. His profit on each paper was $\frac{1}{2}$¢. How many papers did he sell?

**7.** Jack's brother, Harry, sold aluminum ware during the summer vacation and received 45% of his total sales as commission. His sales for June were $640, for July $985, and for August $820. How much was his commission each month? How much was his total commission?

**8.** From the money Harry received as commission he had to pay all of his expenses.

| | |
|---|---|
| Board and room | $148.25 |
| Delivery of orders | 25.48 |
| Travelling and incidental expenses | 164.79 |

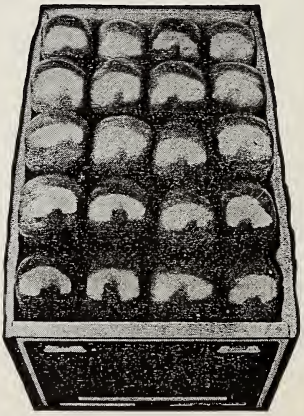
How much did he have left after paying these expenses?

**9.** What per cent of his total commission had he left after paying his expenses?

**Practice in finding commissions.** Find the commissions on the following sales:

| | Sale | Commission | | Sale | Commission |
|---|---|---|---|---|---|
| **1.** | \$500 | $33\frac{1}{3}\%$ | **11.** | \$2,000 | $\frac{1}{2}\%$ |
| **2.** | \$3,000 | 5% | **12.** | \$4,680 | $1\frac{3}{4}\%$ |
| **3.** | \$2,500 | 10% | **13.** | \$2,596 | 20% |
| **4.** | \$4,800 | 6% | **14.** | \$585 | $66\frac{2}{3}\%$ |
| **5.** | \$600 | 7% | **15.** | \$768 | $4\frac{1}{4}\%$ |
| **6.** | \$250 | $3\frac{1}{2}\%$ | **16.** | \$900 | 2% |
| **7.** | \$375 | 25% | **17.** | \$750 | 8% |
| **8.** | \$890 | 40% | **18.** | \$2,000 | $\frac{3}{4}\%$ |
| **9.** | \$980 | 4% | **19.** | \$680 | $4\frac{1}{2}\%$ |
| **10.** | \$480 | $7\frac{1}{2}\%$ | **20.** | \$975 | 5% |

**Net proceeds from sale of fruit.** The Okanagan Valley Orchards sent a shipment of apples to a commission merchant in Toronto. The commission merchant sold the apples and sent the statement shown on page 111 to Okanagan Valley Orchards.



The total amount received by the commission merchant for the fruit sold was \$2,150. This is called *gross proceeds.* His commission is 8% of the gross proceeds.

This amount, together with the freight and cartage, is deducted from the gross proceeds. The remainder, called the *net proceeds*, is sent to the Okanagan Valley Orchards.

**1.** Find all the missing numbers in the statement.

**2.** How do the gross proceeds differ from the net proceeds? Who pays the freight and cartage? Upon what amount is the commission based?

SOLD FOR ACCT. OF Okanagan Valley Orchards — P.O. Kelowna, B.C.
STATION Kelowna, B.C. — DATE OF ARRIVAL 10/20/-

**WATER STREET PRODUCE CO.**
TORONTO, ONT.

DATE SOLD 10/21/-

| QUANTITY | COMMODITY | | PRICE | | GROSS AMOUNT |
|---|---|---|---|---|---|
| 500 bu | MacIntosh Red Apples | 2 00 | 1000 | 00 | |
| 100 bu | Baldwin Apples | 1 75 | 175 | 00 | |
| 150 crts | Cherries | 1 00 | 150 | 00 | |
| 300 bu | Crab Apples | 1 75 | 525 | 00 | |
| 200 bu | Greenings | 1 50 | 300 | 00 | ? |

| CHARGES | | |
|---|---|---|
| Freight | 325 25 | |
| Cartage | 48 00 | |
| Commission 8% | ? | ? |
| Net Proceeds | | ? |

**Problems in finding net proceeds.** Find the commission and the net proceeds in the following:

| | Gross Proceeds | Rate of Commission | Other Charges | | Gross Proceeds | Rate of Commission | Other Charges |
|---|---|---|---|---|---|---|---|
| **1.** | $500 | 3% | $25 | **4.** | $800 | 7% | $18 |
| **2.** | $750 | 2% | $22.50 | **5.** | $3,250 | $\frac{1}{2}$% | $122 |
| **3.** | $125 | 5% | $12 | **6.** | $1,475 | $66\frac{2}{3}$% | .. |

**7.** A book agent sells in a month 24 sets of encyclopaedias at $69 a set. His commission is 20% of the sales. How much in commissions does he receive at the end of the month?

**8.** In a given year a bond salesman sells bonds to the amount of $1,100,000. His commission is $\frac{1}{2}$%. How much does he receive?

**9.** An owner listed his house with a real estate dealer for sale at $9,000. The dealer's commission for selling is $2\frac{1}{2}\%$. How much will the owner receive when the house is sold?

**10.** A farmers' exchange shipped 1,000 bushels of wheat to be sold by a commission house at market price. The grain was sold at $1.60 a bushel. Freight and storage charges were $165. The merchant's commission was 2¢ a bushel. How much did the farmer's exchange receive?

**11.** The Sume Exchange shipped 175 head of cattle to the Toronto market. They averaged 1,100 pounds each. The sale price was $12 a hundredweight. The freight and transfer charges were $650. The broker's commission was 1%. How much did the exchange receive for the shipment?

**12.** The proprietor of a barber shop paid his barber $18 a week and a commission of 10% on all work over that amount. Through the work of this employee the receipts for four weeks were $165. How much was his commission?

**13.** Marion obtained the following subscriptions for magazines during one month:

25 subscriptions to the *Sunshine Magazine* @ $2.00
30 subscriptions to the *Home Magazine* @ $2.50
10 subscriptions to the *Leader Magazine* @ $3.00

She receives a commission of 25%. How much should she remit to each publisher?

***14.** An automobile dealer receives 25% commission on all cars sold by his agency, out of which he allows his salesmen 10%. If John Wilson sells 10 cars at $550 each during January, how much does he earn for his agency? how much does he earn for himself?

### OTHER PROBLEMS IN COMMISSION

**1.** Mr. Johnson sold a house for $6,000. His commission was $300. What was his rate of commission?

*Think:* $300 = ? % of $6,000.

**2.** Mr. Jackson sold cattle for $375. His commission was $15. What was his rate of commission?

**3.** Mr. Johnson sold a farm. His commission was $175. If the rate of commission was 5%, find the selling price of the farm.

*Think:* $175 = 5% of what number.
$175 = .05 × ?
Divide $175 by .05.

**4.** Mr. Jackson received a commission of $75 for selling some hogs. If the rate of commission was 3%, find out how much the hogs were sold for.

**5.** Mr. Trueblood sold a set of books for $50. His commission was 25%. How much was his commission?

*Think:* 25% of $50 = ?

Find the missing numbers below.

| | Selling Price | Commission | Rate of Commission |
|---|---|---|---|
| **6.** | $650 | ? | 2% |
| **7.** | $720 | ? | $3\frac{1}{2}$% |
| **8.** | $400 | $20.00 | ? |
| **9.** | $500 | $17.50 | ? |
| **10.** | ? | $25.00 | 5% |
| **11.** | ? | $16.80 | 4% |
| **12.** | $825 | ? | 4% |
| **13.** | $975 | $58.50 | ? |
| **14.** | ? | $24.80 | 8% |
| **15.** | ? | $30.00 | $7\frac{1}{2}$% |

## REVIEWING APPLICATIONS OF PER CENT

Before finding the missing items below, tell in your own words how to proceed in each group of problems.

| | Total Cost | Selling Price | Profit | Per Cent of Profit Based on Selling Price |
|---|---|---|---|---|
| 1. | $72 | $96 | ? | ? |
| 2. | ? | $100 | $20 | ? |
| 3. | $40 | ? | $10 | ? |
| 4. | ? | ? | $25 | 10% |
| 5. | ? | ? | $30 | 6% |
| 6. | $60 | ? | $15 | ? |
| 7. | ? | $300 | ? | 20% |
| 8. | $860 | $1,000 | ? | ? |

| | Regular Price | Rate of Loss | Loss | Selling Price |
|---|---|---|---|---|
| 9. | $12 | 25% | ? | ? |
| 10. | $20 | 10% | ? | ? |
| 11. | $35 | ? | $7 | ? |
| 12. | $60 | ? | $15 | ? |
| 13. | ? | 20% | $5 | ? |
| 14. | ? | $33\frac{1}{3}$% | $10 | ? |
| 15. | $90 | ? | ? | $81 |

| | Sale | Rate of Commission | Commission | Net Proceeds |
|---|---|---|---|---|
| 16. | $1,000 | 5% | $50 | ? |
| 17. | $3,000 | $2\frac{1}{2}$% | ? | ? |
| 18. | $6,000 | ? | $240 | ? |
| 19. | $750 | ? | $15 | ? |
| 20. | ? | 8% | $24 | ? |
| 21 | ? | 6% | $36.60 | ? |
| 22. | $950 | ? | ? | $855 |
| 23. | $1,000 | ? | ? | $750 |
| 24. | $475 | 4% | ? | ? |

### DISCOUNT

Mr. Stephens manages a large hardware store in dger. Here is a bill which a wholesale merchant nt to him.

**THE JACKSON HARDWARE SUPPLY CO.**

WINNIPEG, MAN.

January 5, 19__

SOLD TO John C. Stephens
Badger, Man.

TERMS: 10 days SHIPPED BY freight

| | | |
|---|---|---|
| 3 Radio B Batteries @ $8.75 | 26.25 | |
| 10 Aerials @ $1.90 | 19.00 | |
| | 45.25 | |
| Discount 40% | 18.10 | |
| | | $27.15 |

The Jackson Hardware Supply Company is a wholesale use which sells many different kinds of hardware in rge quantities to retail dealers. The company furnishes ch dealer with a catalogue containing a description of merchandise at *list prices*. The dealers sell at a dis-unt from these *list prices*. The discount is called *trade commercial discount*. The rate of discount is set by e company and may be changed from time to time as siness conditions demand. For each article that he ys, the dealer pays the *net price;* that is, the *list price* ss the discount.

CAN A

In addition to *trade* or *commercial discount*, a discount is also allowed for prompt payment by most manufacturers and wholesalers.

**1.** What are the list prices for each article of radio equipment that Mr. Smith bought?

**2.** What discount was Mr. Smith allowed on the order?

**3.** What was the total net price of the radio supplies? How was it found? Check each item on the bill.

**4.** Name three retail merchants in your neighborhood.

**5.** Name a wholesale merchant in your neighborhood. How can you tell that he is a wholesale merchant?

**6.** Mr. Smith ordered 12 golf clubs at \$3.20 each. Find the net price of one golf club if he receives a discount of 15%. Find the total net price of the 12 golf clubs.

**7.** Make out a bill for the following articles like the bill on page 115. Show the discount, and the total net price: 25 hatchets at \$.40 each; 30 axes at \$.75 each; 20 hammers at \$.35 each; discount, 25%.

**8.** A dealer buys bicycles listed at \$45. He receives a discount of 20%. What is the net price?

**9.** What is the rate of discount on a sewing machine listed at \$50 and sold for \$40?

Find the discount and the net price on the following:

| | | |
|---|---|---|
| **10.** \$32, 15% | **13.** \$4.20, 15% | **16.** \$350, 12% |
| **11.** \$48, 5% | **14.** \$3.50, 4% | **17.** \$7.50, 6% |
| **12.** \$3.75, 20% | **15.** \$6.70, 30% | **18.** \$9.25, 8% |

**19.** A dealer buys bicycles listed at \$36. He receives a discount of 20%. He is also allowed a discount of 2% on the net price for cash payment. How much does each cost?

### CUMULATIVE TEST II

This test contains many different kinds of examples. If you make any mistakes on the test, practise other examples similar to those that you worked incorrectly. You should be able to complete all of these examples in *fifteen minutes.*

1. $19 - 4\frac{7}{8} =$ (*8*)
2. $16 \times 15\frac{1}{3} =$ (*10*)
3. $6 \div 8 =$ (*12*)
4. $\frac{9}{10} \div \frac{3}{4} =$ (*29*)
5. $.7 + .9 + .4 =$ (*39*)
6. $\frac{2}{3}$ of ? $= 60.$ (*28*)
7. $83.25 - 46.55 =$ (*39*)
8. $100 \times .61 =$ (*45*)
9. $.4 \times .05 =$ (*41*)
10. $998.7 \div 4.5 =$ (*48*)
11. 6% of \$4.50 = (*82*)
12. 3.6 = ? % of 10.8. (*90*)
13. 10 = 5% of ? (*93*)
14. $5\frac{1}{2} + 6\frac{1}{4} + 9\frac{1}{16} =$ (*20*)
15. .5 % = ? decimal. (*79*)
16. $.175 + 4.6 + 22 =$ (*39*)
17. Change $1\frac{7}{1000}$ to a decimal. (*37*)
18. $784 \div 26 =$ ? (carry to 2 places) (*48*)
19. What per cent of 40 is 60? (*90*)
20. $\frac{1}{4}$ T. = — lb.; $\frac{1}{2}$ gal. = — pt. (*225*)
21. Divide 22,560 by 48. (*12*)
22. Find the product of 508 and 698. (*10*)
23. Subtract 4,457 from 13,943. (*8*)
24. Compare $4\frac{1}{2}$ and $13\frac{1}{2}$ by division. (*94*)

### TOPICS FOR SPECIAL REPORTS

1. The budget of the Canadian Government.
2. Variations in prices of food during the year.
3. The cost of furnishing a house.
4. How we can save money in buying.
5. Per cents found in newspapers.
6. Comparative cost of gas and electricity.
7. Make a budget for a young woman.
8. Make a budget for a family.

### PRACTICE TEST IN FRACTIONS—NUMBER V

How many of these examples can you work correctly on your first trial in *five minutes?*

**1.** $\frac{2}{5} \times \frac{4}{5} =$ **2.** $\frac{5}{6} + \frac{8}{9} =$ **3.** $8 - 3\frac{2}{5} =$

**4.** $\frac{3}{4} \div 2 =$ **5.** $3\frac{1}{5} + \frac{7}{10} =$ **6.** $54\frac{1}{3} - 22$

**7.** $7 \div 1\frac{1}{2} =$ **8.** $10\frac{1}{3} \times 6\frac{2}{3} =$ **9.** $1\frac{7}{8} \div 4\frac{2}{3} =$

**10.** $11\frac{2}{3} + 23\frac{2}{6}$ **11.** $42\frac{3}{4} - 6\frac{1}{3}$ **12.** $27\frac{3}{4} + 5$

Continue your practice until you can work all of the examples correctly in *less than five minutes.*

### PRACTICE TEST IN DECIMALS—NUMBER IV

You should be able to work all of these examples correctly in *less than five minutes.* Check your work.

**1.** $9.75 + 4.95 + 6.26 =$
**2.** $7.21 + 8.4 + 9.65 =$
**3.** $27.3 + 8.47 + 9.874 =$
**4.** $97.2 - 84.6 =$
**5.** $39.466 - 18.5 =$
**6.** $64.2 - 18.37 =$
**7.** $.3 \times .46 =$
**8.** $3.5 \times 1.75 =$
**9.** $52.8 \times .31 =$
**10.** $675.9 \div .3 =$
**11.** $388.85 \div .011 =$
**12.** $.989 \div 7.5 =$
**13.** Change $\frac{8}{9}$ to a decimal fraction of three places.
**14.** Change .625 to a common fraction.

How many mistakes did you make in placing the decimal points in the answers? How many mistakes occurred because of errors in your computation? Practise this exercise until you can work all of the examples correctly in less than five minutes. Keep a record in your notebook of your trials of this test.

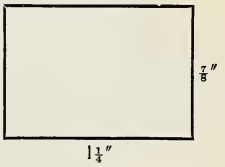
### PRACTICE TEST IN PERCENTAGE—II

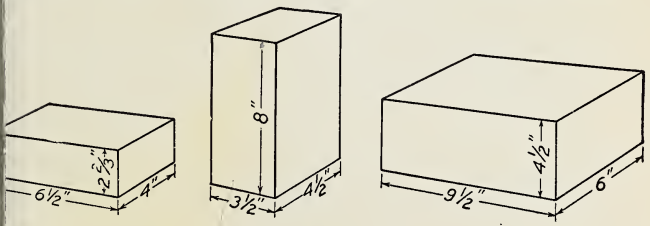
You should be able to work all of these examples correctly in *less than five minutes.* Check your work.

1. Express as per cents: $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{10}$, $\frac{1}{5}$.
2. Express as per cents: .05, .12, .125, .2, 1.4, .16$\frac{2}{3}$.
3. Which of the following equal .05: $\frac{1}{10}$, $\frac{1}{20}$, 5%, $\frac{5}{100}$, 50%.
4. *a.* Express as decimals: $\frac{1}{2}$%, $\frac{1}{4}$%, $\frac{1}{8}$%, $\frac{1}{10}$%.
   *b.* Find $\frac{1}{4}$% of 75; $\frac{1}{8}$% of 120; $\frac{1}{2}$% of 55.
5. What is 6% of \$140? of \$200? of 50 pounds?
6. What per cent of 120 pupils are 40 pupils? 60 pupils? 30 pupils?
7. Twenty per cent of what number equals 15? 20? 40? 80? 1,000?

### REVIEW OF AREA AND VOLUME

1. Find the perimeter of the rectangle below:
2. Find its area.
3. Find the area of a rectangle 3.5 inches long and 4.2 inches wide.
4. What is the volume of each of the following rectangular solids?



### PROBLEM SCALE II

*Try to make a better score than you did in Problem Scale I.*

1. In a sixth-grade class, 60% of the pupils were boys. What per cent were girls?

2. A man bought a farm for $16,575, paying $85 an acre. How many acres were there in the farm?

3. Alice bought $2\frac{1}{2}$ yards of ribbon at 32 cents a yard. How much change should she receive from a dollar?

4. How many quarter-pound boxes will $5\frac{1}{2}$ pounds of candy fill?

5. To make badges of the school colours for one pupil, $\frac{5}{8}$ yard of ribbon is required. If the ribbon costs 20 cents a yard, how much will the badges for 36 pupils cost?

6. Doris bought a hat, regularly priced at $6.00, for $4.50. What was the per cent of reduction?

7. Find the volume of a tank, 6 ft. by $7\frac{1}{2}$ ft. by 9 ft.

8. A merchant paid $37.50 for a suit that he sold for $55. What per cent of the selling price was his margin?

9. A lumber dealer sold 7,500 feet of lumber at $32.50 per thousand feet, through an agent who charged $6\frac{1}{2}$% commission. How much did the dealer receive?

10. How much less than 25% of 120 is $\frac{1}{4}$% of 120?

### VOCABULARY EXERCISE

Explain briefly the meaning of the following words:

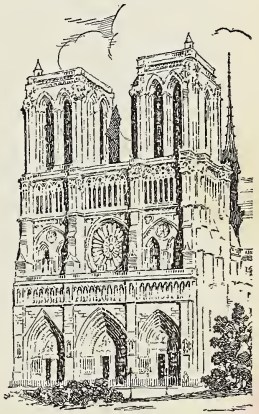
1. decimal
2. reduction
3. bill
4. ounce
5. per cent
6. budget
7. income
8. account
9. cancellation
10. cubic foot
11. thrift
12. increase
13. standard
14. cheque or check

The Quebec Bridge—Note the use of lines and angles

## SECTION IV

### GEOMETRY IN ARCHITECTURE

Have you ever studied carefully the designs found in pictures of beautiful buildings? The picture at the right represents the entrance of a church. On the following page is a picture of one of the most beautiful pieces of architecture in the world, Giotto's tower in Florence. Let us examine the two pictures and note the elements of the designs.



**1.** In drawing designs of buildings, architects make use of lines, squares, rectangles, triangles, circles and other geometric figures. Point to different figures in the design of the entrance shown here; in the design of Giotto's tower.

**2.** Which of the two pictures shows the greater variety of different kinds of geometric figures? Name some of these figures.

**3.** The corners of squares and other rectangles are called *right angles*. Find at least three right angles in each picture. Which design makes the greater use of right angles?

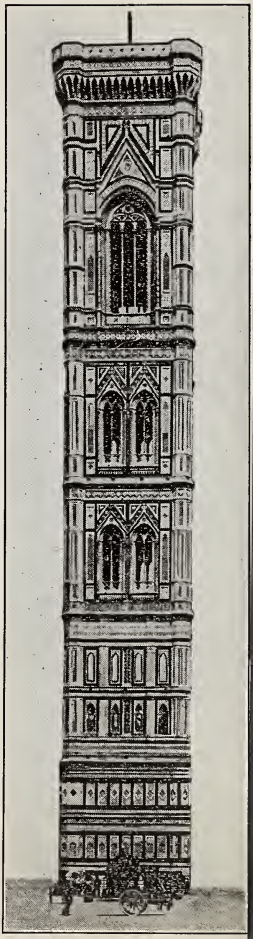
**4.** Note the corners in the triangular shaped roof over the entrance on page 121. Which of the angles are smaller than right angles? Which are larger? Angles that are smaller than right angles are called *acute* angles. Angles that are larger than right angles are called *obtuse* angles. What kinds of angles are there in the two triangles near the top of Giotto's tower?

**5.** Find parts of the designs of these two pictures that are examples of rectangles and parts of circles used together.

**6.** Can you find illustrations of imperfect triangles in the design of Giotto's tower? in the design of the entrance?

**7.** Circles that have the same center are called *concentric* circles. Point to the use of concentric circles in the design of the entrance of the church.

***8.** Examine the front of some building. Locate different geometric figures and different kinds of angles. Make a sketch of some part of the design.



### USING COMPASSES AND RULER

The most convenient way of drawing a circle is with compasses. Set one point of the compasses at the point which is to be the center of the circle. Then trace the circle with the other point.

**1.** A circle of any desired size may be drawn. Open the compasses until they are $1\frac{1}{2}$ inches apart. Then draw a circle.

**2.** The distance from the center of a circle to any point on the circumference is called the *radius*. What is the length of the radius in problem **1**? Draw the radius of the circle and label it *radius*.

**3.** Draw another radius and extend it in a straight line to the other side of the circle. This line is the *diameter* of the circle. Label it *diameter*.

**4.** The radius of a circle is 2 inches. Find its diameter.

**5.** Draw a circle whose diameter is 3 inches. How long is the radius of the circle?

**6.** Draw three circles whose radii are equal to lines *A*, *B*, and *C*, respectively, using the same center. These circles are *concentric* circles because the same center is used for all of them. Find concentric circles in the picture on page 121.

A ——————————

B ——————————

C ——————————

**7.** Draw two diameters of a circle. How many diameters of a circle can be drawn? how many radii?

**8.** Draw two circles of different size using the same center. How many circles can be drawn with the same center?

**9.** Draw a circle on the blackboard, using a string tied to a piece of chalk. Why is this circle less accurate than one drawn with compasses?

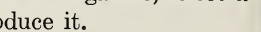
***10.** Try to reproduce the design of part of the exterior view of the Parliament Building (*frontispiece*). Use compasses and a ruler.

***11.** From the advertising pages of a magazine, select a design based on a circle and reproduce it.

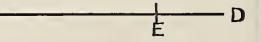
### HOW TO MEASURE LINES

Compasses, or dividers, are often used to find the length of lines or to lay off lines of a desired length.

To measure the length of the line $AB$, fix the sharp point of the compasses at $A$. Separate the points of the compasses until the other point rests exactly on $B$. Place the points of the compasses on a ruler, and measure the distance between the points. This gives the length of the line (segment) $AB$.



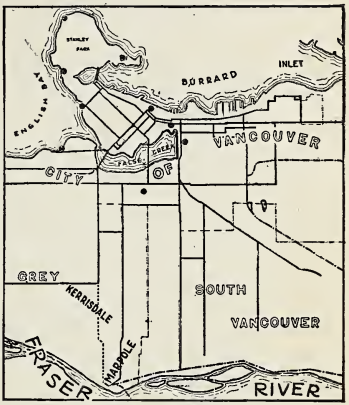

To lay off $1\frac{5}{16}$ inches on $CD$, open the points of the compasses until they are $1\frac{5}{16}$ inches apart, as measured by a ruler; fix the sharp point of the compasses at $C$ and strike an arc cutting $CD$ at $E$. $CE$ is the desired length.



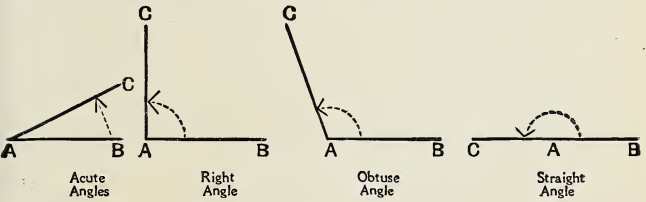

Why are measurements likely to be more nearly accurate when made with compasses than with a ruler?

## WHAT WE MEAN BY AN ANGLE

This map pictures some of the streets in a certain city. Where the streets cross, they form corners. In mathematics we call these corners *angles*. The size of an angle is measured by the amount of change of direction of the lines forming it.




An angle is formed by a line rotating about a fixed point. For example, if the line $AC$ rotates about the point $A$, the greater the amount of rotation the larger the angle. In each case the angle $BAC$ is formed.




A *right angle* is a quarter of a complete revolution. The sides make a square corner like the corner of a page.

An *acute angle* is less than a right angle.

An *obtuse angle* is greater than a right angle but less than a straight angle, or two right angles.

A *straight angle* is half a complete revolution. It is equal to two right angles, which together make a straight line.

**1.** Which of the angles below are right angles? Which are acute angles? Which are obtuse angles?

**2.** At three o'clock the hands of the clock are at right angles to each other. Show this by a drawing.

Show by a drawing the angle which the hands of a clock make at 3:10. What kind of angle is formed?

**3.** What kind of angle is formed by the hands of the clock at the following hours? Make a drawing in each case: 6:00; 9:35; 3:45; 2:30; 2:50; 1:15; 8:50.

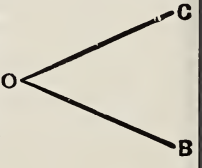
**4.** From a point, draw a line pointing north and one pointing west. What kind of angle is formed?

**5.** From the same point, draw a line pointing west and one pointing southeast. What kind of angle is formed?

**6.** Construct one angle illustrating each kind shown on the preceding page.

**7.** Examine the picture of the exterior of the Parliament Building (*frontispiece*). Point to four right angles; four acute angles. Are there obtuse angles in the picture? Are there straight angles?

*O* is called the *vertex* of the angle *BOC*. *OB* and *OC* are called the *sides* of the angle.




**8.** How many vertices has a triangle? a square? Compare this number with the number of sides.

**9.** Point to angles of the four kinds in your classroom. Make a drawing showing angles made by streets near your school. Name the angles.

## READING ANGLES

Angles may be read in three ways:

*a.* With three letters.

The angle in *Figure 1* is read *angle ABC*. The letter at the vertex is always read second.

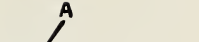


Fig. 1

*b.* With one capital letter.

The angle in *Figure 2* is read *angle B*. The capital letter is placed at the vertex outside the angle.

Fig. 2

*c.* With one small letter.

The angle in *Figure 3* is read *angle a*. The small letter is at the vertex inside the angle.

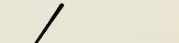
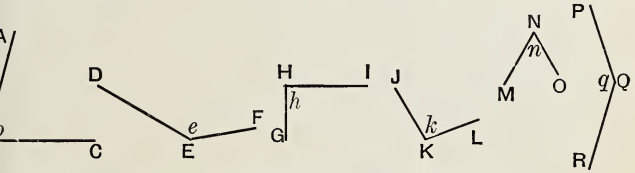


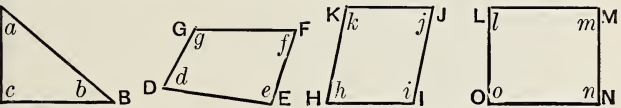
Fig. 3

1. Read the angles on page 125.

2. Which of the following angles are right angles? hich are acute? which are obtuse? Name each angle n two ways.



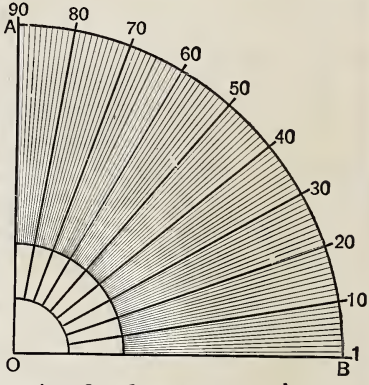

3. Read the angles in these figures in two ways:




4. Draw an acute angle and letter it *ABC*.

## MEASURING AND CONSTRUCTING ANGLES—THE DEGREE

Just as we measure length by a unit length, such as the inch or foot, we measure the size of an angle by a unit angle called a *degree*. There are 90 degrees (90°) in a right angle. The figure at the right is a right angle divided into 90 small angles, each equal to 1 degree.




Four right angles placed together about a point $O$ take up all the space around the point. Hence, the sum of all angles that can be drawn around a point must equal four right angles ($4 \times 90°$ or 360 degrees).

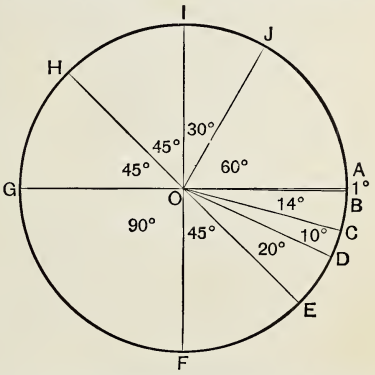
**1.** At the center of this circle there are four equal angles. How many degrees are there in each angle?

**2.** How many degrees are there in each angle at the center of a circle if there are 5 equal angles? 3 equal angles?

**3.** How many degrees are there in half a right angle? in one fourth of a right angle? in one third of a right angle?

**4.** How many degrees are there in the angle formed by the hands of a clock at 9 o'clock? at 3 o'clock? at 4 o'clock?

The sides of each of the 1-degree angles in the right angle on page 128 cross $AB$ and divide it into small parts. Any part of a circle is called an *arc*. Since there are 90 *1-degree angles* in the right angle, the arc $AB$ is divided into 90 small arcs. Each of these small arcs is equal to an arc of 1 degree. There are, therefore, 360 degrees in a whole circle.

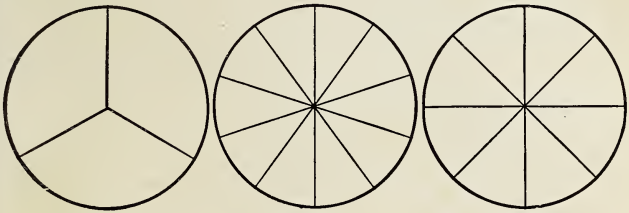



**5.** How many degrees are there in each arc of this circle?

**6.** Draw a circular face of a clock showing 9 o'clock. How many degrees are there in the arc formed if the hands of the clock are extended until they cross the circle?

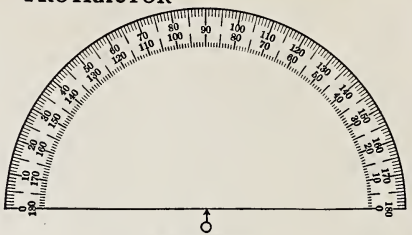
**7.** Through how many degrees does the minute hand of a clock pass in $\frac{1}{4}$ hour? in $\frac{1}{2}$ hour? in 1 hour? in 10 minutes? in 25 minutes?

**8.** Into how many parts has each of the following circles been divided? How many degrees are there in each part?



CAN A

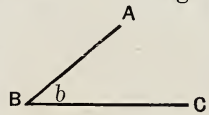
## MEASURING AND CONSTRUCTING ANGLES—THE PROTRACTOR

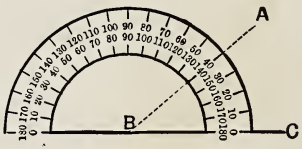


A Protractor

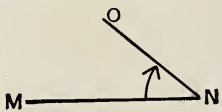
The instrument used to measure the size of an angle is called a *protractor*. Protractors have different shapes, but the one used most commonly is shaped like a half circle. The straight edge is the diameter of a circle, and the point $O$ is the center of a circle. Along the curved edge of the protractor above are two scales marked off in degrees. How many degrees are there in each scale?

Suppose that you wish to measure the size of the angle $ABC$. Place the protractor so that the middle point $O$ on the straight edge of the protractor is at $B$, the vertex of the angle, and the straight edge falls on the side $BC$, as shown in the figure. The side $AB$ of the angle cuts the curved outer scale at the 40° mark. The angle $ABC$ therefore equals 40°. To measure an angle like $MNO$, use the outer scale for the number of degrees in the angle.

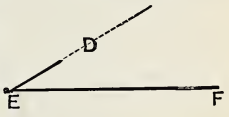


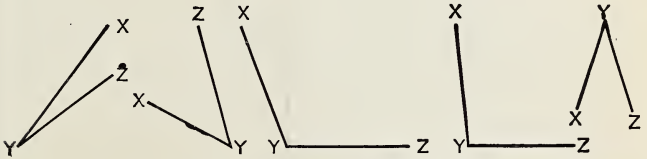

**1.** Draw two angles of convenient size, similar to $ABC$ and $MNO$. Measure the angles with a protractor.



**2.** Henry tried to measure the angle *DEF* with his protractor, but he found that the side *DE* did not reach the scale of the protractor. With his ruler he extended the line *DE* until it was long enough to reach the scale. Then he measured the angle. If either side of an angle is not long enough to reach the scale of the protractor, extend it until it crosses the edge of the protractor.




**3.** On your paper draw angles similar to those below and measure them with a protractor. Compare your measurements with those of your classmates.

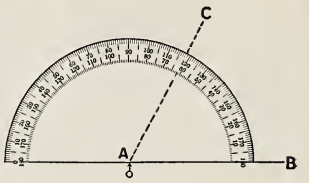



**4.** On your paper draw three angles of different sizes. Number them *1*, *2*, and *3*. In a table like the one below write your estimate of the number of degrees in each; then check your estimates by measuring the angles with a protractor. How many degrees was your greatest error of estimate? How many degrees was your average error of estimate? Compare your errors of estimate with those of your classmates.

| Angle | Estimated Size | Correct Measure | Error of Estimate |
|---|---|---|---|
| 1..... | | | |
| 2..... | | | |
| 3..... | | | |

## HOW TO CONSTRUCT AN ANGLE OF A GIVEN SIZE WITH A PROTRACTOR

In addition to measuring angles, a protractor may also be used to construct quite accurately angles of desired sizes. Suppose that you wish to construct an angle of 63°. Proceed as follows:




**1.** Draw a line $AB$ which is to be one side of the angle. Use $A$ as the vertex of the angle. Place your protractor on line $AB$ with the center at vertex $A$ and the zero mark on the scale lying on line $AB$. Find the 63° mark on the scale and make a dot $C$ at that point on the paper. Remove the protractor and draw the line $AC$. The angle $BAC$ thus formed equals 63°.

**2.** Use the method explained above to draw an angle of 48°.

**3.** Construct angles of 75°, 15°, 68°, 80°, 110°, 31°, 135°. In each angle write the number of degrees it contains.

**4.** Use your protractor to draw a right angle; an acute angle of 45°; an obtuse angle of 145°.

**5.** Use your protractor to mark the even hours on the face of a clock, using as the face a 2-inch circle. How many degrees do you allow for each minute mark?

**6.** There is usually a slight error in constructing an angle with a protractor. Is this error likely to be as great as the error when an angle is drawn without the aid of a protractor? Why is it quite difficult to draw an angle of exactly 48°?

### DRAWING TO SCALE

All maps and plans of houses are drawn to scale; that is, a distance, such as a foot, is represented by a shorter distance, such as an inch or a fraction of an inch. To find the true measurements, the dimensions in a plan must first be translated into *scale values*. Thus, in a plan drawn to a scale of 1 inch to 1 foot, a line $2\frac{1}{2}$ inches long represents a line $2\frac{1}{2}$ feet long.

**1.** In the following table fill in the missing numbers, using the scale, 1″ to 1′.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Actual length*..... | 1′ | 3′ | 7′ | 9′ | | 15′ | |
| *Scale length*..... | 1″ | 3″ | | | 11″ | | 20″ |

**2.** A desk top is 3 feet by 4 feet. Using the scale of 1 inch to 1 foot, what are the dimensions of the desk top in a scale drawing? Draw the desk top to scale.

**3.** Fill in the missing numbers in the following table. The scale is $\frac{1}{2}$ inch to 1 foot.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Actual length*..... | 1′ | 2′ | 8′ | 9′ | | 16′ | |
| *Scale length*..... | $\frac{1}{2}$″ | 1″ | | | 6″ | | $9\frac{1}{2}$″ |

**4.** Fill in the missing numbers in the following table. The scale is $\frac{1}{4}$ inch to 1 foot:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Actual length*..... | 2′ | | 8′ | | 10′ | 17′ | |
| *Scale length*..... | $\frac{1}{2}$″ | 1″ | | $2\frac{1}{2}$″ | | | 6″ |

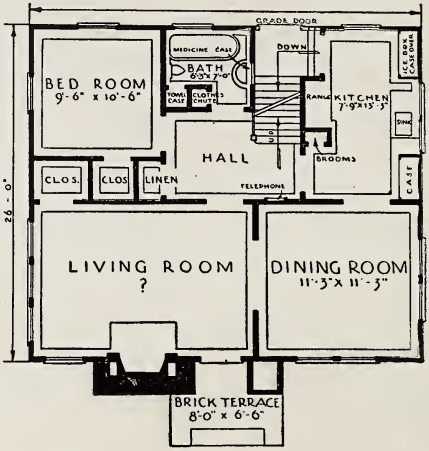
**5.** A garden is 40 feet long and 35 feet wide. Make a scale drawing of the garden, scale 1 inch to 10 feet.

**6.** Draw the plans of the following rooms:

| | Room | Dimensions | Scale |
|---|---|---|---|
| *a.* | Living room | 12′ x 14′ | $\frac{1}{4}$″ to 1′ |
| *b.* | Bedroom | 11′ x 11′ | $\frac{1}{2}$″ to 1′ |

## HOUSE PLANS AND MAPS

This is the plan of the first floor of a bungalow that Alice's father is building at Sylvan Lake.




**1.** How long is the bungalow?

**2.** To find the width of the bungalow, we must find to what scale the plan is drawn.

First measure the length of the plan correct to the nearest sixteenth of an inch. We know that the length of the house is just 26 feet. Therefore, in the plan, one inch represents how many feet? The house is drawn to the scale of 1 inch for .... feet.

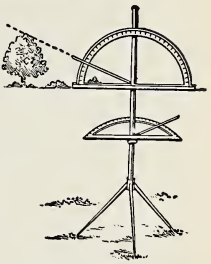
**3.** Measure the width of the plan carefully. How can you find the width of the house if you know the width of the plan and the scale to which the plan is drawn?

**4.** Find the dimensions of the living room.

**5.** On a house plan drawn to the scale of 1 inch to 15 feet, how long is a line that represents a distance of 30 feet? 20 feet? 40 feet?

**6.** On a house plan drawn to the scale of 1 inch to 12 feet, how long a distance is represented by a line 2 inches long? by a line $1\frac{3}{4}$ inches long? by a line $\frac{7}{8}$ inch long?

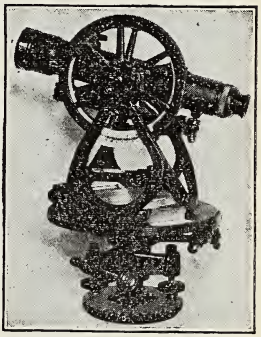
### CONSTRUCTING A FIELD PROTRACTOR



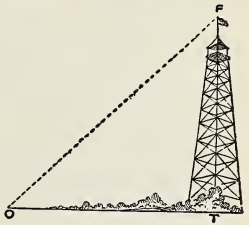
At the right is a drawing of a field protractor. Point to the tripod; the upright rod; the horizontal protractor; the vertical protractor. A field protractor is very easy to construct. With it you can measure angles out of doors or in your classroom quite easily. Possibly you may wish to construct a field protractor.

### A TRANSIT

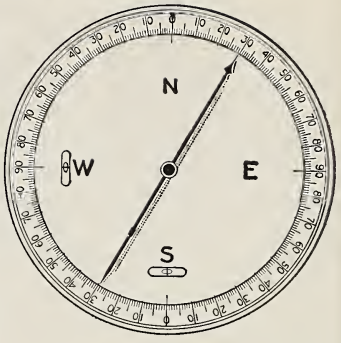
If angles out of doors are to be measured very accurately, surveyors and engineers use a *transit*. This instrument has a telescope, a protractor to measure vertical angles, and a protractor to measure horizontal angles. On some transits each degree of the protractor scale is divided into 60 smaller angles called *minutes*, and each minute into 60 angles called *seconds*. In determining the height of the observation tower in the picture, the engineer, standing at *O*, sights the top of the tower through his telescope and reads on the vertical protractor of his transit the size of angle *O* in degrees, or, if he wishes, in minutes.



A transit



## HOW TO USE A COMPASS




Woodsmen and navigators use the compass to help find directions. Examine this compass carefully. You can see that a compass is a double protractor.

1. Name the directions on the compass.

2. Northeast is halfway between north and east (N and E). Point on the compass to northeast; southeast; northwest; southwest.

3. How many degrees is it from east to northeast?

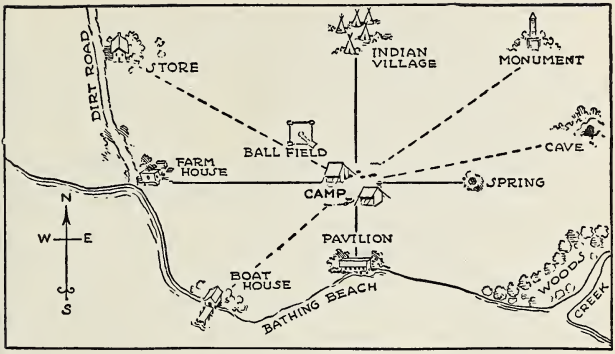
4. A ship in distress was reported to a rescuing ship as being about ten miles from shore and 40° north of east of a certain point. Draw a map showing this.

5. Locate a place on the same map approximately 10° west of north; 30° west of north; 30° east of north.

6. Examine the sketch of a Boy Scout camp on the opposite page. Name a place due east of the camp; a place due north of the camp. Name an object due west of the camp.

7. Name an object not exactly east of the camp, but in an easterly direction. We say the cave is north of east from the camp.

8. What place is west of north? west of south? Mariners, surveyors, and others express the direction in degrees. The cave is about 10° north of east from the camp.

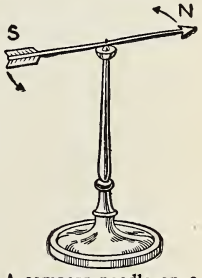



**9.** In what direction from the boathouse is the pavilion? about how many degrees north of east?

**10.** Look at a map in a geography textbook. Select some places on the map and tell what direction from your community each is. Use estimates of degrees when necessary.

**11.** Find on the map two places 45° west of north of your neighborhood; two places 30° south of east.

*12. Make a copy of the map of this camp, showing the distance and the direction of the cave, monument, store, and boathouse from the center of the camp. Include in the drawing the east-west and the north-south lines drawn through the center of the camp. If the map is drawn to the scale of 1 inch to $\frac{1}{2}$ mile, how far is it from the camp to each of the places named above?



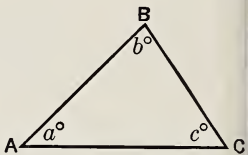

**A compass needle on a stand. The arrows show how the point of the needle will turn toward the north.**

## FINDING THE NUMBER OF DEGREES IN THE ANGLES OF A TRIANGLE—THE ANGLE-SUM RULE

Architects and surveyors frequently make use of what is called the *angle-sum rule*. The following exercises will explain this rule.

**1.** Estimate the number of degrees in each angle of the triangle $ABC$. Enter your estimates in a table.

| Angle | Number of Degrees | |
|---|---|---|
| | Estimated | Measured |
| A..... | | |
| B..... | | |
| C..... | | |
| Sum..... | | |




**2.** Measure angles $A$, $B$, and $C$ with your protractor and record your results in the same table.

**3.** Find the sum of the three angles as measured by the protractor.

**4.** Draw a triangle $ABC$ having a different shape. Measure each angle and enter your results on a form similar to the one above. Find the sum of the angles.

**5** How much difference is there between the results you found for problems **3** and **4**?

If your work is correct, the sum of the angles of any of the triangles you have drawn is approximately 180°.

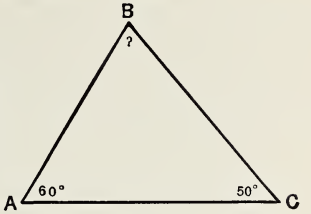
*Angle-sum rule: The sum of the angles of a triangle is 180°.*

$$a^\circ + b^\circ + c^\circ = 180^\circ$$

Explain each letter in the statement.

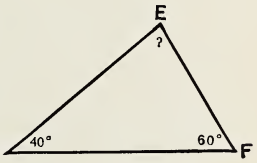
## Using the Angle-sum Rule

**1.** Harry saw a surveyor measure the angles at $A$ and $C$ with a transit, as he sighted $B$. To find the angle at $B$ the surveyor simply added 60° and 50°, and subtracted the sum from 180°.

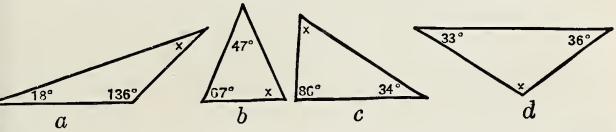



Explain why 70° is the correct size of the angle at $B$.

**2.** Find the size of angle $E$ in this triangle.




**3.** Find the third angle in each of the triangles below. Check the problems **1** to **3** with a protractor.



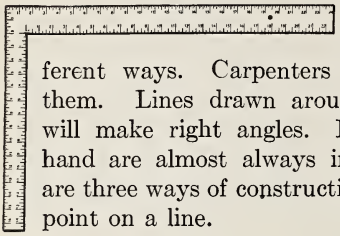

**4.** If one angle of a triangle is a right angle, how many degrees are there in the sum of the other two angles?

**5.** Here are pictures of triangles used by architects in drawing some of the important angles used in designing. The first is called a 30°–60° right triangle and the second a 45° right triangle, having two angles of that size.

Point to the angles of each size in the two triangles.

**6.** How large is the largest angle in each triangle?

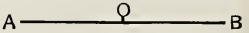
## HOW TO CONSTRUCT RIGHT ANGLES



Right angles may be constructed in many different ways. Carpenters use squares to construct them. Lines drawn around square-cornered cards will make right angles. Right angles drawn free-hand are almost always inaccurate. Why? Below are three ways of constructing a right angle at a given point on a line.

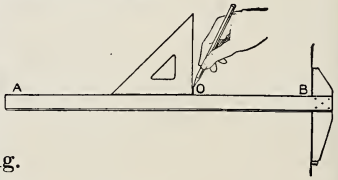
### I. Using a Protractor

Draw a line like $AB$ on your paper. Locate a point $O$ on the line. With a protractor construct an angle of 90° with the vertex at $O$. A line that makes an angle of 90° with another line is *perpendicular* to that line.



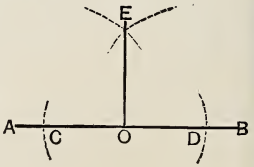

### II. Using a Right Triangle

Slide a right triangle along $AB$ to the point $O$. Draw a line upward along the edge of the triangle. This method is commonly used in mechanical drawing.




### III. Using Compasses

With $O$ as the center and with a convenient radius, measure off equal distances from $O$ at $C$ and $D$ on $AB$. With $C$ and $D$ as centers and a radius longer than $CO$, draw arcs intersecting at $E$.



Draw *EO*. *EO* is perpendicular to *AB* at the point *O*. Prove this by measuring the angles at *O*.

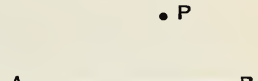
**1.** Construct perpendiculars to lines according to each of the three methods.

**2.** Which of the three methods do you find to be the easiest?

**3.** Which method would you use if you wished to be quite accurate?

**4.** The third method is used to draw perpendiculars to lines on a blackboard. Instead of compasses use a piece of string tied to a piece of chalk.

**5.** Devise a way of constructing a perpendicular to line *AB* from the point *P*. Use a protractor or triangle.



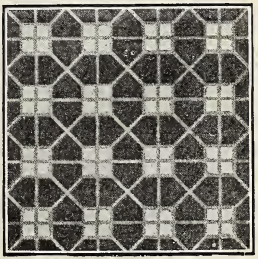

**6.** Place a point *P* one inch below line *AB*. From this point draw a perpendicular to the line.

**7.** Draw a vertical line *AB*. Place dots one inch to the left and to the right of the line. Draw perpendiculars to the line from these points.

**8.** Point out illustrations of right angles in the picture of the Parliament Building (*frontispiece*). Which of the ways that have been described for constructing right angles do you think is used by architects?

**9.** Point to illustrations of right angles in the design for linoleum at the right.

**10.** Make a drawing of a part of the design of linoleum at the right.



**A design for linoleum**

## HOW TO CONSTRUCT RECTANGLES AND SQUARES

### I. Using a Protractor

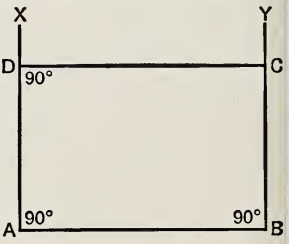
The facts that you have learned in constructing right angles will help you in drawing rectangles and squares.

1. How do the sides of a rectangle compare in length?

2. What kind of angles has a rectangle? How many angles?

*A rectangle is a four-sided figure whose angles are all right angles.*

3. With a protractor and ruler draw a rectangle whose length, or *base*, is $1\frac{1}{2}$ inches and whose height, or *altitude*, is 1 inch.




*Method:* Draw a line segment $AB$ equal to $1\frac{1}{2}$ inches. At $A$ and $B$ construct right angles with the protractor. On $AX$ measure $AD$ equal to 1 inch. At $D$ construct a right angle with the protractor. Extend the side of the right angle at $D$ until it intersects the line $BY$. Call the intersection point $C$. $ABCD$ is the required rectangle. Measure angle $DCB$ to see if it is a right angle. If $DCB$ is a right angle, the four-sided figure is a rectangle because it has four right angles.

4. Construct with a protractor rectangles having the following dimensions:

*a.* Base $2\frac{1}{2}$ inches, altitude 2 inches.
*b.* Base $1\frac{3}{4}$ inches, altitude 1 inch.
*c.* Base 5 inches, altitude 3 inches.

**CONSTRUCTING AN ANGLE EQUAL TO A GIVEN ANGLE**

An angle equal to a given angle may be drawn without the use of a protractor.

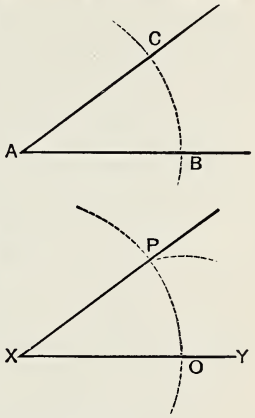
Suppose the angle $A$ is the given angle.

Draw a line of convenient length, such as $XY$.

With $A$ as a center draw an arc cutting the sides of angle $A$ at $B$ and $C$.

With the same radius and with $X$ as the center draw an arc cutting $XY$ at $O$.

With compasses measure the distance from $C$ to $B$, the rotation of angle $BAC$.




Using the distance from $C$ to $B$ as a radius and with $O$ as a center, draw an arc at $P$. Connect $X$ and $P$. Angle $YXP$ is the desired angle, equal to angle $BAC$.

**1.** Draw an angle on your paper similar to angle $A$. Using the method described above, construct an angle of the same size as the one you have drawn.

**2.** With a protractor draw an angle of 40°. With compasses and ruler construct an angle equal to it. Check your construction by measuring the angle with a protractor.

**3.** With compasses and ruler draw a right angle. Use the method outlined above to construct an angle equal to it.

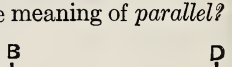
**4.** Construct with a protractor an obtuse angle of 120°. With compasses construct an angle equal to it.

**5.** Draw an obtuse angle and also an acute angle. With compasses construct angles equal to them.

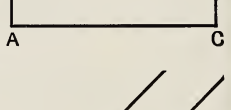
## HOW TO CONSTRUCT PARALLEL LINES

On an automobile trip, Jack's father said, "There is a good road a mile north of here which runs parallel to this road." Jack did not understand what was meant by *parallel*. How would you explain to him the meaning of *parallel?*

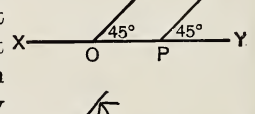
**1.** The lines $AB$ and $CD$ are drawn at right angles to $AC$. What kind of angle does each make with $AC$? Would the lines $AB$ and $CD$ meet if they were extended? *Parallel lines are lines equally distant from each other at every point.* Hence, $AB$ and $CD$ are parallel.




**2.** With a protractor construct on $XY$ a line from any point $O$ at an angle of 45°, and another from a point $P$ at an angle of 45°. Why are these lines parallel?

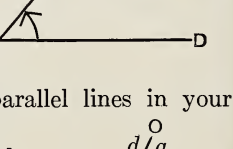



**3.** $AB$ and $CD$ are parallel lines. Measure the angles at $A$ and $C$. How do they compare?



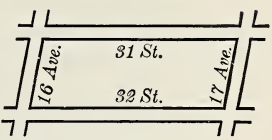

**4.** Point to three examples of parallel lines in your classroom.

**5.** The two parallel lines $EF$ and $GH$ are cut by another line, $PO$. $PO$ is called a *transversal.* How do angles $a$ and $e$ compare in size?




**6.** Two equal angles, such as angles $a$ and $e$, that have corresponding positions in parallel lines cut by a transversal are called *corresponding angles.* Name three other pairs of corresponding angles in the figure.

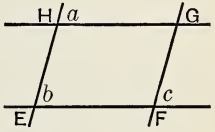
## HOW TO CONSTRUCT A PARALLELOGRAM




On a city map a figure like the one at the right was formed by four streets. The opposite sides of the figure are parallel. A four-sided figure in which the opposite sides are parallel is called a *parallelogram.*

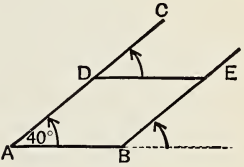
**1.** Name two pairs of parallel lines in the parallelogram.

**2.** The figure *EFGH* is formed by two pairs of parallel lines. What kind of figure is it?




**3.** How do angles *b* and *a* compare in size? Show that angle *b* equals angle *c*.

**4.** You can construct a parallelogram by using the facts that you learned in problems **2** and **3**. Draw a line *AB*. At *A* draw an angle of 40°. Label the line *AC*. Choose a point *D* on *AC*. Draw a line through the point *D* parallel to *AB*. To construct this line, how large must you make the angle at *D*?




At *B* draw a line parallel to *AC*. To do this, how large must you make the angle at *B*? Show that *ABED* is a parallelogram.

**5.** Construct a parallelogram with an angle *A* equal to 50°, side *AB* $1\frac{3}{4}$ inches long, and side *AD* $1\frac{1}{4}$ inches long.

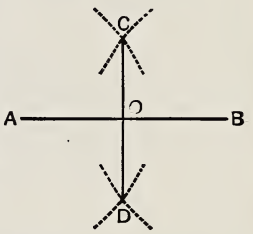
**6.** Use the method in problem **4** to draw a rectangle; to draw a square.

***7.** An oblique parallelogram having all sides equal is called a *rhombus.* Make a copy of this rhombus.

### HOW TO BISECT A LINE

A line, the exact length of which is not known, may be divided into two equal parts (bisected) by means of compasses and a ruler, without first measuring its length.

*Method:* Draw a line $AB$ of any length. With a radius of more than half of $AB$ and with $A$ and $B$ as centers draw arcs that intersect above and below $AB$ and mark the intersections $C$ and $D$. Connect points $C$ and $D$. Label the point where $CD$ intersects $AB$ with the letter $O$.




**1.** Measure $AO$ and $BO$. How do they compare in length? What does this show?

**2.** Measure the angles at $O$. How many degrees are there in each? This shows that $CD$ is .... to $AB$. In mathematics, $CD$ is called the *perpendicular bisector* of $AB$.

**3.** Draw a line $5\frac{1}{2}$ inches long. Bisect it by the method described in this exercise. Show that the perpendicular bisector passes exactly through the middle of the line.

**4.** Draw a line of any length. With compasses, divide it into four equal parts; into eight equal parts.

**5.** Draw a line about the width of this page. Construct a square whose perimeter is equal to the length of this line.

***6.** Construct a figure similar to the figure at the right.

***7.** Draw a line of any convenient length. With compasses, divide it into eight equal parts.

***8.** Draw a square. Bisect each side of the square.

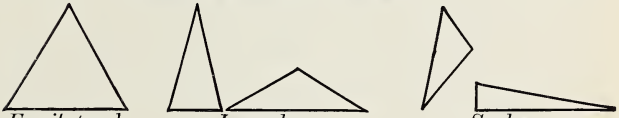
### CLASSIFICATION OF TRIANGLES

**I.** According to the number of sides that are equal:

*a.* A triangle having three sides equal is called an *equilateral* triangle;

*b.* A triangle which has two sides of equal length is called an *isosceles* triangle;

*c.* A triangle which has no sides of equal length is called a *scalene* triangle.



*Equilateral* *Isosceles* *Scalene*

**II.** According to the size of their angles:

*a.* A triangle which has three acute angles is called an *acute* triangle. When all of its angles are equal it may be called an *equiangular* triangle;

*b.* A triangle which has a right angle is called a *right* triangle;

*c.* A triangle which has an obtuse angle is called an *obtuse* triangle.

*Acute* *Equiangular* *Right* *Obtuse*

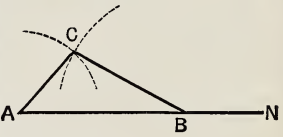
1. Which of the following triangles are acute? obtuse? right? isosceles? equilateral? scalene?

*a* *b* *c* *d* *e* *f* *g*

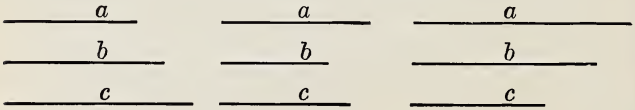
## HOW TO CONSTRUCT TRIANGLES

**1.** Suppose that you wished to construct a triangle whose sides are equal respectively to the three line segments, $a$, $b$, and $c$.

First draw a line $AN$. With your compasses mark off from $A$ a distance $AB$ equal to the segment $a$. Open the compasses a distance equal to $c$. Place the sharp point of the compasses at $A$, and make an arc as shown in the diagram. With $B$ as a center and a radius equal to $b$, draw an arc crossing the first arc at the point $C$. Then draw the lines $AC$ and $BC$. The triangle $ABC$ thus formed is the desired triangle. Prove with your ruler that the sides of the triangle equal the three segments $a$, $b$, and $c$.




**2.** Use the method described above to draw triangles having sides equal to the following segments:



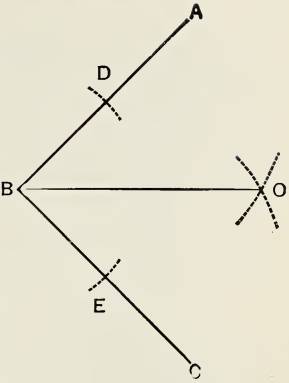

**3.** Construct a triangle having sides of $1\frac{1}{2}$ inches, 2 inches, and 1 inch. Measure these distances on a ruler with your compasses.

**4.** Construct a triangle having sides of $1\frac{1}{2}$ inches, $1\frac{3}{4}$ inches, and $1\frac{1}{4}$ inches.

**5.** Construct a triangle with sides each $1\frac{3}{4}$ inches long.

**6.** Construct a triangle having one side of $1\frac{1}{2}$ inches and two sides each of $1\frac{1}{4}$ inches.

### HOW TO BISECT AN ANGLE




To *bisect* an angle is to divide it into two equal angles. This can be done either with a protractor or with compasses. If you have an angle of 60° on your paper, how can you divide it into two angles of 30° each with the protractor?

Any angle can be divided with compasses into two equal angles, as follows: Draw any angle such as *ABC*. With a convenient radius and with *B* as a center, draw arcs intersecting *AB* and *BC* at *D* and *E*. Then using *D* and *E* as centers, draw arcs intersecting at *O*. Draw *OB*.

With your protractor, measure angles *CBO* and *OBA*. If your work has been done accurately, they are equal in size. Therefore line *OB* bisects angle *ABC*.

**1.** On your paper draw any angle of convenient size. Bisect the angle.

**2.** Draw an angle of 80°. Bisect it with the protractor. Show with compasses that the angle has been bisected.

**3.** Draw an obtuse angle. Bisect it.

**4.** Draw a triangle. Bisect each of the angles. Extend the bisectors until they intersect. What do you find?

**5.** Draw a straight angle. Bisect it. How many degrees are there in each half of the straight angle?

**6.** Use your compasses to construct the following angles: 45°; $22\frac{1}{2}$°; $67\frac{1}{2}$°; 135°.

## CUMULATIVE TEST III

This test contains many different kinds of examples. If you make any mistakes in the test, practise other examples similar to those that you worked incorrectly. Use the index at the back of the book to locate suitable exercises. You should be able to complete all of these examples in *fifteen minutes.*

**1.** $6\frac{7}{8} + 4\frac{5}{6} + 2\frac{3}{4} =$ (*20*)

**2.** $8\frac{1}{3} - 4\frac{7}{8} =$ (*20*)

**3.** $2\frac{2}{3} \times 3\frac{3}{4} =$ (*24*)

**4.** $4\frac{1}{2} \div 6 =$ (*29*)

**5.** $8\frac{1}{3} \div 1\frac{1}{9} =$ (*29*)

**6.** $.6 + .8 + .9 =$ (*39*)

**7.** $.34 + 43 + 0.3 =$ (*39*)

**8.** $9.2 - 1.645 =$ (*39*)

**9.** $.09 \times 9.56 =$ (*41*)

**10.** $1.6 \times 305 =$ (*41*)

**11.** $648 \div 1.2 =$ (*48*)

**12.** $.4983 - 1.1 =$ (*48*)

**13.** $33\frac{1}{3}\%$ of 96 = (*82*)

**14.** What per cent of 3 is 2? (*90*)

**15.** 15% of ? = 45. (*93*)

**16.** 18 = ? % of 90. (*90*)

**17.** Change $1\frac{2}{25}$ to a decimal. (*37*)

**18.** Express .0025 as a per cent. (*78*)

**19.** What part of 80 is 24? (*88*)

**20.** $\frac{1}{4}$ mi. = — yd.; $\frac{1}{2}$ bu. = — pk. (*28*)

**21.** Divide 119,340 by 234. (*12*)

**22.** Subtract 86,753 from 164,312 (*8*)

**23.** Find the product of 569 and 437. (*10*)

**24.** Find the sum of 8,892; 8,776; 7,987; 9,969; 8,899; 9,377; and 6,999. (*6*)

**25.** Find the ratio of 160 to 50; of 50 to 160. (*88*)

**PRACTICE TEST IN FRACTIONS—VI (5 minutes)**

1. $\frac{1}{3} + \frac{5}{6} =$
2. $27\frac{3}{4} - 8 =$
3. $12 \times 6\frac{3}{5} =$
4. $7 - \frac{8}{11} =$
5. $\frac{9}{10} \div \frac{2}{3} =$
6. $\frac{9}{10} + 6\frac{3}{5} =$
7. $5\frac{5}{8} \div 6 =$
8. $6\frac{2}{3} + 5 =$
9. $8\frac{1}{4} \times \frac{3}{7} =$
10. $\frac{9}{10} \times 5 =$
11. $29\frac{3}{8} - 12\frac{3}{4} =$
12. $12\frac{1}{2} \div \frac{10}{11} =$

What were the causes of any mistakes that you made on this test? Compare your score with scores on previous tests.

**PRACTICE TEST IN DECIMALS—V (5 minutes)**

Check your work.

1. $8.7 + 5.6 + 9.3 =$
2. $17.43 + 9.26 + 8.1 =$
3. $.26 + 8.74 + 93.1 =$
4. $96.8 - 5.9 =$
5. $28.25 - 13.5 =$
6. $27.1 - .653 =$
7. $.67 \times .8 =$
8. $.6 \times 1.42 =$
9. $.743 \times 62 =$
10. $.656 \div .8 =$
11. $3.64 \div .07 =$
12. $72.8 \div .33 =$
13. Change $8\frac{7}{9}$ to a decimal.
14. Change $.66\frac{2}{3}$ to a common fraction.

Did you make mistakes similar to those that you made on previous tests? Compare your score with score on Test IV.

**PRACTICE TEST IN PERCENTAGE—III (5 minutes)**

1. Express as per cents: $\frac{1}{2}$, $\frac{1}{4}$, $1\frac{1}{5}$, $3\frac{1}{3}$.
2. Find 6% of: 120; 75; \$3.60; \$10.
3. Find 125% of: 35; 100; 90; 800.
4. 15 is what per cent of: 30; 20; 10; 18.
5. 12 is 10% of ——; 15% of ——.
6. 200% of a number is how many times the number?
7. Express 15%, $12\frac{1}{2}$%, and $\frac{1}{4}$% as decimals.
8. Which is more, .3 or 25%?

### EVERYDAY USES OF DENOMINATE NUMBERS

**1.** Helen is 4 feet 6 inches tall. How much shorter is she than Tom, who is 5 feet 4 inches tall?

**2.** Margaret needs three pieces of ribbon, each 2 feet 4 inches in length. How much ribbon does she need in all?

**3.** Our school begins at 8:45 in the morning and we have recess at 10:15. How long is it from the beginning of school to recess?

**4.** The floor of our dining room is 12 feet 6 inches long and 10 feet 4 inches wide. What is its area?

**5.** How much more gasoline must I put into a 14-gallon tank to fill it if there are already 3 gallons 1 quart in the tank?

**6.** Mary had a piece of lace 5 feet 8 inches long. She cut it into four equal pieces. How long was each piece?

**7.** What is the volume of a cake of ice 1 foot 3 inches long, 1 foot 2 inches wide, and 18 inches thick? Express the answer in cubic feet.

**8.** One morning Jack picked 48 quarts of strawberries. How much more than a bushel did he pick?

**9.** A butcher sold 3 pounds 8 ounces of meat at 48 cents a pound. How much did he charge for the meat?

**10.** Alice made 3 pounds 6 ounces of candy which she wished to divide into 4 equal parts. How many ounces should she put into each part?

**11.** Harry walked 4 miles in 1 hour and 15 minutes. How long did it take him on the average to walk a mile?

**12.** How much moulding would be needed for a strip around a room 12 feet 6 inches long and 10 feet 8 inches wide?

### REVIEW OF IMPORTANT POINTS

1. Name the tools of geometry about which you have studied.

2. Explain the meaning of the word *geometry*.

3. What are some of the causes of error in measuring lengths of lines? How do the tools of geometry help us to make our measurements more nearly correct?

4. Explain what we mean when we say that a measurement is approximately correct.

5. What is meant by "drawing to scale"? Give two good illustrations.

6. Write a sentence about each of the following: compasses, radius, diameter, angle, protractor, compass.

7. Explain the difference between a right angle and an acute angle; an acute angle and an obtuse angle.

8. In what three ways may angles be read? Give an illustration of each.

9. Construct an angle of 60°; of 110°. Bisect them.

10. Construct a two-inch square.

11. Draw a triangle and measure the three angles. On the triangle indicate the number of degrees in each angle. Classify the triangle in two ways.

12. How many degrees are there in the sum of all the angles of a triangle?

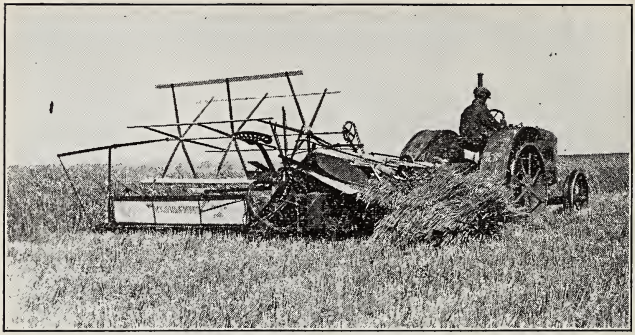
13. What is the difference between a protractor and a transit?

14. Is the size of an angle changed by extending its sides? Explain.

15. How many degrees are there in the sum of all of the angles that can be drawn around a point?

16. Draw a three-inch line. Bisect it.

17. Construct a parallelogram with a $1\frac{1}{2}$-inch base.



## MEASURING RECTANGLES

**Finding areas.** In mathematics the word *area* refers to the size of a surface.

It is important to know how to measure areas. We measure window frames to find how much netting is needed to cover the windows. If we wish to find the size of the carpet for a room, we must find the area of the room. If we wish to find how much sod is needed to cover a lawn, we must know the area of the lawn. We must know the area of the walls and ceiling of a room to find the amount of surface to be painted.

Give two other illustrations of the need of knowing how to measure areas.

**1.** Harry has a field 10 rods long and 16 rods wide. John has a field 12 rods long and 15 rods wide. Which has the larger field? how much larger?

To decide which has the larger field you must find the *area* of each of the two fields. The area of a rectangle may be found by multiplying the length by the

width when both are expressed in the same unit of measure. This rule may be expressed more briefly with letters. $A = l \times w$, or $A = lw$. This formula is read: *Area equals length times width.*

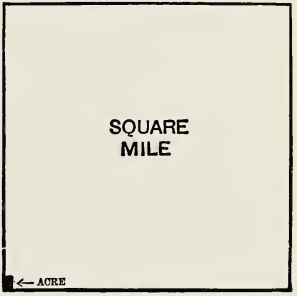
When letters are used to express multiplication the $\times$ sign is omitted. Thus $lw$ means $l$ *times* $w$.

**2.** Use the formula, $A = lw$, to find the areas of rectangles of the following dimensions. Answer orally:

***a.*** 3 ft., 2 ft. ***b.*** 7 in., 3 in. ***c.*** 4 yd., 3 yd.

**3.** ***a.*** Draw a rectangle 3 inches by 4 inches. Draw lines dividing the rectangle into square inches. Show that the rectangle contains 12 square inches.

***b.*** On the blackboard draw a rectangle equal to a square yard. How many square feet does it contain?




**4.** There are 640 acres in a square mile; that is, in a piece of land one mile square. How many acres are there in a small dairy farm $\frac{1}{2}$ mile long and $\frac{3}{4}$ mile wide?

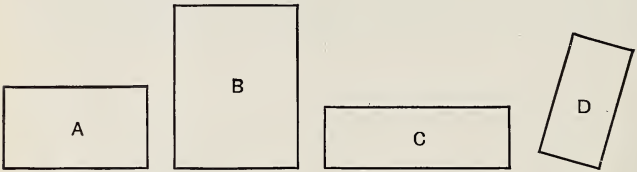
Find the areas of rectangles having the following dimensions:

| | Length | Width | | Length | Width |
|---|---|---|---|---|---|
| **5.** | 180 mi. | 75 mi. | **8.** | $\frac{3}{4}$ mi. | 80 rd. |
| **6.** | $7\frac{1}{2}$ ft. | $6\frac{1}{2}$ ft. | **9.** | 2.5 ft. | 18 in. |
| **7.** | 1.5 rd. | 2.25 rd. | **10.** | 1.6 rd. | 16.5 yd. |

**11.** Estimate the number of square inches in a sheet of tablet paper. Find its area. How much in error was your estimate?

**12.** Estimate the area of the floor of your classroom. Measure its dimensions and find its area; also find the difference between this area and your estimated area. Compare the estimates of your classmates with your estimate. Whose estimate was nearest the measured area?

**13.** Carefully measure the dimensions of the following rectangles. What is the area of each? How much more or less than a square inch does each contain?




**14.** On your paper draw a square equal to 1 square inch.

**15.** What is the area of a square, each of whose sides is 6 inches? 5 inches? 10 inches? 12 inches? 3 feet? 4 yards?

**16.** If you increase the length of a rectangle, what happens to its area?

**17.** If you increase both the length and width of a rectangle, what happens to its area?

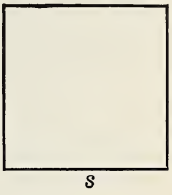
**18.** If you double the length of the side of a square, how many times do you increase its area?

**19.** If you increase the length of a rectangle and decrease its width, what may happen to its area? Prove your answer is correct.

## USING FORMULAS FOR FINDING AREAS AND PERIMETERS

The use of formulas helps us to work problems about the areas and perimeters of squares and other rectangles.

**1.** In this square, $s$ represents the length of one side. Show that $A = s \times s$.




The quantity $s \times s$ may be written as $s^2$. The formula for finding the area of a square may be written as

$$A = s^2$$

This formula is read, "$A$ equals $s$ squared."

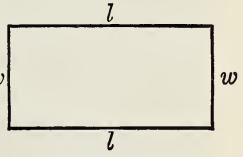
**2.** The small $^2$ in the formula is called an *exponent.* It shows the number of times $s$ is multiplied by itself. How much is $3^2$? $5^2$? $10^2$?

**3.** How many square inches are there in the area of a square each side of which is 12 inches?

*Think:* $A = s^2$.
Since $s$ is 12 inches, $s^2 = 12^2$, or $12 \times 12$.
$A = 12 \times 12 = 144$ square inches.

**4.** Find the area of a square each of the sides of which is 25 inches; 30 inches; $1\frac{1}{2}$ feet; 2.5 yards.

The *perimeter* of a surface means the distance around it. Explain how to find the distance around a rectangle, such as the one at the right. In this rectangle which letter represents the length? the width?




**5.** Explain in words each of the following statements and show that each is correct:

*a.* $P = l + w + l + w$.
*b.* $P = 2l + 2w$.
*c.* $P = 2 \times (l + w) = 2(l + w)$.

Formula $b$ is the one we shall use in finding the perimeters of rectangles.

**6.** Find the perimeter of a rectangle if $l$ is 4 inches and $w$ is 6 inches.

*Think:* $P = 2\,l + 2\,w$.
$P = (2 \times 4) + (2 \times 6) = 8 + 12 = 20$.
The perimeter of the rectangle is 20 inches.

Find the perimeters of rectangles with the following dimensions:

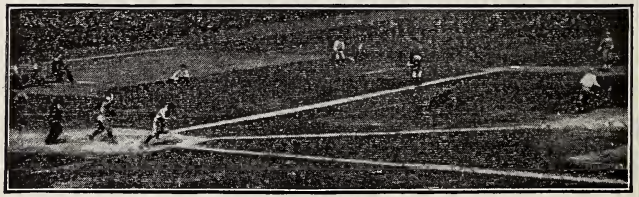
| | Length | Width | | Length | Width |
|---|---|---|---|---|---|
| **7.** | 45 ft. | 12 ft. | **10.** | 100 yards | 45 yards |
| **8.** | 100 in. | 36 in. | **11.** | 80 rd. | 40 rd. |
| **9.** | 16 mi. | 7 mi. | **12.** | 5 ft. 6 in. | 8 ft. 4 in. |

**13.** Show that the perimeter of a square may be expressed by the formula, $P = 4s$.

**14.** How long is the perimeter of a square each side of which is 10 inches?

*Think:* $P = 4\,s$.
$= 4 \times 10$ in.
$= 40$ in.

**15.** The player in the picture has hit a home run. If the distance between bases is 90 feet and he runs on the base lines, how many feet must he travel in order to score?



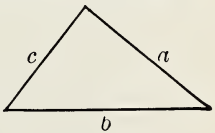
Can A

**16.** A square field each side of which is approximately 210 feet is equal to an acre. How long is the perimeter of such a field? How many steps $2\frac{1}{2}$ feet long must you take in walking around the outer edge of the field?

**17.** Show that the perimeter of a triangle may be found by the following formula:

$$P = a + b + c$$

**18.** Find the perimeter of the triangle on this page by measuring the lengths of $a$, $b$, and $c$.




**19.** Find $P$ if $a$ is $1\frac{1}{2}$ inches; $b$, $1\frac{1}{4}$ inches; and $c$, $1\frac{3}{4}$ inches.

**20.** Find $P$ if $a$ is 5.5 feet; $b$, 6.75 feet; and $c$, 10.375 feet.

***21.** Find the perimeter of your school grounds.

***22.** Measure in some near-by field a piece of ground equal to an acre.

### FINDING THE LENGTH OF THE SIDE OF A SQUARE

You have learned that 4 is the square of 2. Therefore a square, having an area of 4 square feet, has sides 2 feet in length. In mathematics we say that 2 is the *square root* of 4, because $2 \times 2 = 4$.

Find the length of the sides of squares having the following areas:

**1.** 25 square inches
**2.** 81 square inches
**3.** 100 square feet
**4.** 1 square mile
**5.** 9 square feet
**6.** 121 square yards
**7.** 16 square feet
**8.** 36 square yards
**9.** 64 square rods
**10.** 169 square inches
**11.** 196 square feet
**12.** 225 square inches

**13.** What is the square root of 49? of 144? of $\frac{1}{4}$?

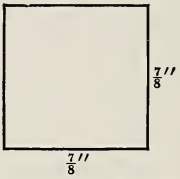
## HARRY BUILDS A RABBIT CAGE

**1.** Harry wishes to find the number of feet of wire fencing he will need in order to build a fence around his rabbit cage. The cage will be 8 feet long and 5 feet wide. How many feet of fencing will he need? To find how much fencing will be needed, Harry must measure the *perimeter* of the cage.

**2.** How much will the wire fencing cost at 25 cents a foot?

**3.** What is the perimeter of each rectangle on page 156?

**4.** What is the perimeter of a square each side of which is $\frac{7}{8}$ inch?

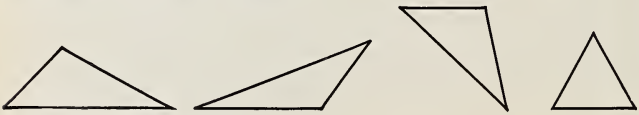



**5.** Find the perimeter of a square each side of which is 1 inch; .7 inch; 10 yards; $\frac{5}{6}$ inch; 11.5 yards; 75 rods.

**6.** How many fence posts are needed for a fence around a square garden 50 feet long, if a post is needed every 10 feet?

**7.** Find the perimeter of the cover of this mathematics book; the perimeter of one of the type pages.

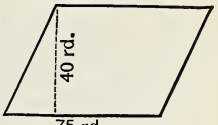
**8.** Measure carefully the sides of these triangles and find the perimeter of each:



CAN A

### FINDING THE AREA OF A PARALLELOGRAM

John's father owned a field having the shape and dimensions indicated by the figure. He wished to find the area of the field.




Study Figures 1 and 2 carefully.

If Triangle *y*, one side of which is the altitude of the parallelogram, were cut off the left end of the parallelogram in Figure 1, and placed at the right end of the parallelogram in Figure 2, there would be formed another figure having a different shape but the same area as Figure 1. Show that *ABCD* in Figure 2 is a rectangle having the same length and height as the parallelogram.

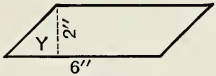


Fig. 1

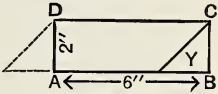


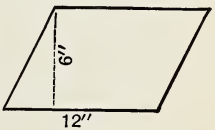
Fig. 2

**1.** How do you find the area of the rectangle, Figure 2? What is its area in square inches?

**2.** What is the area of the parallelogram in Figure 1? You see that its *area is equal to the product of its length* (*base*) *and its width* (*altitude*). $A = lw$, or $A = ba$.

**3.** Find the area of the field which John's father owned.

**4.** Find the area of a flower bed having the dimensions given in the figure at the right.



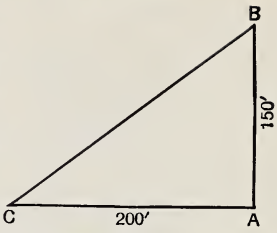

Find the areas of parallelograms having the following dimensions:

| | Base | Altitude | | Base | Altitude |
|---|---|---|---|---|---|
| **5.** | 12 ft. | 8 ft. | **8.** | $24\frac{1}{2}$ mi. | 40 mi. |
| **6.** | 16.5 yd. | 1.5 yd. | **9.** | $7\frac{1}{2}$ in. | $5\frac{3}{4}$ in. |
| **7.** | 28 rd. | 20 rd. | **10.** | 15 ft. | $12\frac{1}{2}$ ft. |

***11.** Draw a parallelogram. Label and measure its base and altitude. Find its area.

## FINDING THE AREA OF A TRIANGLE

A contractor was asked to submit an estimate of the cost of covering a park with sod. The park was shaped like the right triangle *CAB*. Must the contractor find the area or the perimeter of the triangle?




The following exercises will show you how to find the area of a triangle:

**1.** What is the area of the rectangle in Figure 1?

**2.** How does the area of triangle *EFG* compare with the area of the rectangle *ABCD?* Draw a small rectangle and divide it into two triangles. Match the triangles. How do they compare in size?

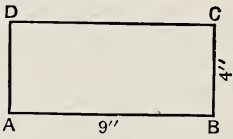


Fig. 1

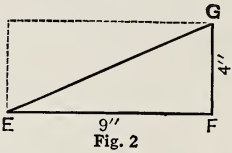


Fig. 2

You can see that the *area of the triangle* (Fig. 2) *is one half the area of the rectangle,* or $A = \frac{1}{2}\ BA$. $\frac{1}{2}$ of $9 \times 4 = ?$

**3.** What is the area of the parallelogram in Figure 3?

**4.** How does the area of the triangle in Figure 4 compare with the area of the parallelogram in Figure 3?

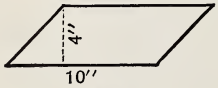


Fig. 3

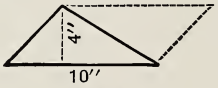


Fig. 4

Draw a parallelogram and cut it into two triangles. How do they compare in size?

You can see that the *area of the triangle equals half the area of the parallelogram having the same base and altitude.*

From these exercises we may conclude that *the area of any triangle equals one half of its base times its altitude.*

This rule may be expressed by the following formula:

$$A = \tfrac{1}{2}\, ba.$$

This formula is read, *Area equals one half the base times the altitude.*

**5.** Find the area of a triangle the base of which is 10 feet and the altitude 4 feet.

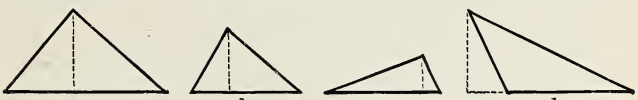
*Think:* $A = \frac{1}{2}\, ba.$
$A = \frac{1}{2} \times 10 \times 4.$
$A = 20$ square feet.

**6.** How many square feet are there in the area of the park which is to be sodded? What is the cost of the sod at 10 cents a square foot?

Find the areas of triangles with the following dimensions. Be sure to express them in the same units:

| | Base | Altitude | | Base | Altitude |
|---|---|---|---|---|---|
| **7.** | 14 in. | 6 in. | **12.** | 16 yd. | 15 ft. |
| **8.** | 12 ft. | 9 ft. | **13.** | 18 in. | $1\frac{1}{2}$ ft. |
| **9.** | $8\frac{1}{2}$ yd. | 3 yd. | **14.** | 16 mi. | 8 mi. |
| **10.** | 18 yd. | 8 yd. | **15.** | 4 ft. 3 in. | 5 ft. 4 in. |
| **11.** | 24 rd. | 48 rd. | **16.** | 9.25 ft. | 6.375 ft. |

**17.** On your paper draw triangles similar to those below and draw the altitudes. Carefully measure the base and altitude of each triangle and then find its area.



## FINDING THE CIRCUMFERENCE OF A CIRCLE

A wheel has a diameter of 2 feet 4 inches. How many revolutions does the wheel make in going a mile? To answer this question you must know how to find the circumference of a circle.

The members of a class in arithmetic brought circular objects to school to use in an exercise in measuring circumferences and diameters. Here are some of the measurements:

| Object | Circumference | Length of Diameter | Ratio of Circumference to Diameter |
|---|---|---|---|
| Plate | $27\frac{1}{2}$ in. | $8\frac{3}{4}$ in. | 3.14 |
| Phonograph record | $31\frac{1}{2}$ in. | $9\frac{7}{8}$ in. | ? |
| Quart jar | $12\frac{3}{4}$ in. | 4 in. | ? |
| Gallon can | $20\frac{1}{2}$ in. | $6\frac{1}{2}$ in. | ? |

**1.** How was the ratio 3.14 found? What does it show?

**2.** Find the other three ratios. Carry the work to two decimal places.

**3.** You can see that the four ratios are all more than 3. This shows that the circumference was in each case a little more than three times the diameter of each object. Find the average of the four ratios.

Mathematicians have proved that the ratio is about 3.1416. This number is represented by the Greek letter $\pi$, spelled *pi*, and pronounced like *pie*.

**4.** Measure the diameter of the tire and the length of the path of the tire at the top of this page. Then find their ratio to determine if the drawing is accurate.

The circumference of a circle equals about 3.1416 times the length of the diameter. For ordinary work $3\frac{1}{7}$ is used for the value of $\pi$.

Using $C$ for circumference, $d$ for diameter, and $r$ for radius, the formulas for finding the circumference of a circle are:

$$C = \pi d, \text{ or } C = 2\,\pi r.$$

**5.** Find the circumference of a circular flower bed whose diameter is 8 feet.

*Think:* $C = \pi d$.
$d = 8$ ft.
$C = \pi \times 8 = 3.1416 \times 8 = 25.1328$ ft.
When $3\frac{1}{7}$ is used as the value of $\pi$,
$C = 3\frac{1}{7} \times 8 = 25\frac{1}{7}$ ft.

**6.** Find the circumference of the outer edge of an automobile tire the diameter of which is 35 inches.

**7.** Find the circumference of a circle having a radius of 14 feet.

**8.** Which wheel makes the greater number of revolutions in a mile, one with a diameter of 3 feet or one with a diameter of 3 feet 6 inches? Why?

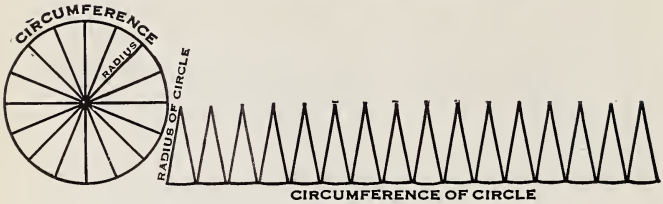
**9.** At \$.75 a yard, what is the cost of the six-inch lace used to trim the edge of a circular table cover 4 feet 8 inches in diameter?

**10.** Find the diameter of a circle whose circumference is 22 feet.

**11.** Find the radius of a circle whose circumference is 44 ft.

**12.** Find $C$ if $r = 8$ ft.
**13.** Find $d$ if $C = 66$ ft.
**14.** Find $r$ if $C = 11$ ft.
**15.** Find $d$ if $C = 40$ ft.
**16.** Find $r$ if $C = 54$ ft.
**17.** Find $C$ if $r = 3\frac{2}{3}$ ft.

### FINDING THE AREA OF A CIRCLE




Cut a circle into 16 or more equal sections as shown above. Each section will be approximately a triangle. Consider the cut circle opened as in the above figure. You can see that the sum of the bases of the triangles which make up the area of the circle equals the circumference of the circle. The altitude of each triangle is equal to the radius of the circle. The sum of the areas of all these triangles is equal to the area of the circle. Since the area of each section is equal to $\frac{1}{2}$ the radius times its base, *the area of the circle must be equal to* $\frac{1}{2}$ *the radius times the circumference.*

Stated in letters, we have: $A = \frac{1}{2} r \times C$.

Since the circumference equals $2 \pi r$, the formula for the area of a circle may be expressed as follows:

$$A = \tfrac{1}{2} r \times 2 \pi r = \pi r^2$$

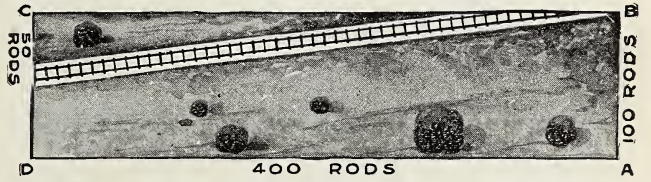
In the following problems, use $3\frac{1}{7}$ for the value of $\pi$.

1. Find the area of a circle whose radius is 10 inches.
2. Find the area of a circle whose radius is 100 feet.
3. Which has the larger area and how much, a square 5 feet on a side or a circle whose diameter is 5 feet?
4. Find the areas of circles with the following radii:

*a.* 4 ft. *b.* 50 ft. *c.* 75 ft. *d.* 15 ft. *e.* 8 ft.

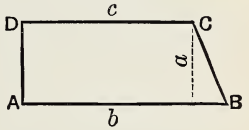
### FINDING THE AREA OF A TRAPEZIUM

**1.** Mr. Jones owned a rectangular piece of ground. Its dimensions are given in the sketch below. A new railroad track was built diagonally through the field to the northeast corner. The track cut the west side of the field 50 rods from the northwest corner. The railroad offered to purchase the triangular piece of ground at $200 an acre. Mr. Jones accepted. How much did he receive?




**2.** Which two sides of the remainder of the field are parallel? Which two sides are not parallel?

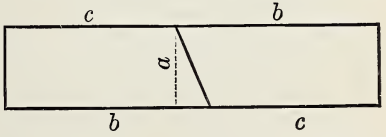
**3.** A four-sided figure which has two parallel sides and two sides that are not parallel is called a *trapezium.*




*a.* Show that *ABCD* is a trapezium, if *b* and *c* are parallel.

*b.* What is its height or altitude?

*c.* Use *b* for *AB*, and *c* for *DC*. Call its altitude *a*.




*d.* Cut out two trapeziums like *ABCD*. Fit them together as shown above. You can see that a parallelogram is formed. Its base is $b + c$, and its altitude $a$. Its area may be expressed by the formula $A = a \times (b + c)$, or $A = a(b + c)$.

**4.** Find the volume of a bin 10 feet long, 8 feet wide, and 6 feet deep.

*Think:* $V = 10 \times 8 \times 6 = ?$ cubic feet.

Find the volumes of rectangular solids with the following dimensions:

| | Length | Width | Height |
|---|---|---|---|
| **5.** | 8 in. | 9 in. | 4 in. |
| **6.** | 6 ft. | 5 ft. | 7 ft. |
| **7.** | 9 yd. | 8 yd. | 12 yd. |
| **8.** | 3 ft. | 2 yd. | 6 ft. |
| **9.** | $3\frac{1}{2}$ in. | $7\frac{1}{2}$ in. | 9 in. |
| **10.** | 2.5 ft. | 4.2 ft. | 6.4 ft. |

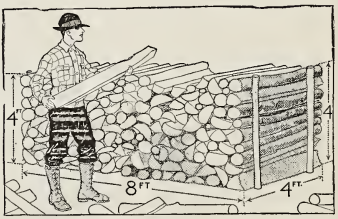
**11.** A tank is 6 feet long, 4 feet wide, and 3 feet deep. How many gallons will it contain if there are approximately $6\frac{1}{4}$ gallons to the cubic foot?

**12.** How many cubic inches are there in a piece of wood, each dimension of which is 1 foot?

**13.** How many cubic inches are there in a lump of coal 2 feet by 3 feet by 4 feet?

### MEASURING WOOD

**1.** Fire wood is usually sold by the cord. A cord represents a pile of 4-foot lengths, 4 feet high and 8 feet long. How many cubic feet are there in a cord?



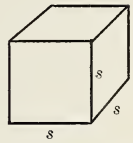

**2.** A good-sized schoolroom is 23 feet wide, 32 feet long, and 12 feet high. Would it hold 15 cords?

**3.** How many cords would there be in a level-full truck whose capacity is 5 cubic yards?

## OTHER WAYS OF EXPRESSING VOLUMES

**1.** At the right is a picture of a cube. Each of its edges has the same length. If we let $s$ represent the length of an edge, its volume may be represented by the expression

$$V = s \times s \times s, \text{ or } s^3.$$



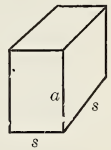

**2.** Find the volume of a cube whose dimensions are each 4 inches; 2.5 feet; $1\frac{1}{4}$ yards; $\frac{1}{2}$ mile.

**3.** Which is greater, a solid 2 feet by 4 feet by 6 feet, or a 4-foot cube? How much greater?

**4.** At the right is a picture of a rectangular solid whose base is a square. If we represent each side of the base by $s$ and the altitude by $a$, then the volume of the solid may be represented by the expression,

$$V = s \times s \times a \text{ or } s^2a.$$

Remember that $s \times s = s^2$; so $s \times s \times a = s^2 \times a$, or $s^2a$.




**5.** Find the volume of a rectangular solid whose base is a square, 4 inches on a side, and whose altitude is 5 inches.

Substituting values in the formula, we find that

$$V = 4 \times 4 \times 5 = \text{?} \text{ cubic inches.}$$

**6.** Find the volume of a rectangular solid whose base is a square $3\frac{1}{2}$ feet on a side, if its altitude is 8 feet.

**7.** Which has the greater volume, a 5-foot cube, or a rectangular solid whose base is a square $4\frac{1}{2}$ feet on a side, with an altitude of 6 feet? how much greater?

***8.** Give three formulas for finding volume and a problem to be solved by each formula.

**USING FACTS YOU HAVE LEARNED ABOUT GEOMETRY**

This exercise will help you to review the important facts that you have learned about geometry.

**1.** Name four kinds of angles. Draw an illustration of each.

**2.** Name three different kinds of triangles and draw one of each.

**3.** Draw a perpendicular to a line that will bisect the line. Check your construction with ruler and protractor.

**4.** Bisect a right angle. Check your construction work with a protractor.

**5.** Draw three lines that are parallel. How do you know that they are parallel?

**6.** Draw an angle of convenient size. Construct an angle equal to it.

**7.** Draw a triangle of convenient size. Construct a triangle of the same size and shape.

**8.** What does $s^2$ mean in the formula, $A = s^2$?

**9.** Express each of the following formulas in words:

| | |
|---|---|
| ***a.*** $A = \frac{1}{2}\,ab$ | ***e.*** $C = 2\,\pi r$, or $\pi d$ |
| ***b.*** $A = lw$ | ***f.*** $A = \pi r^2$ |
| ***c.*** $A = ba$ | ***g.*** $V = lwh$ |
| ***d.*** $A = s^2$ | ***h.*** $d = 2\,r$ |

Memorize these formulas and be able to use them.

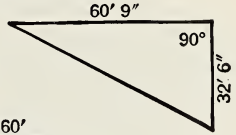
Write problems that may be solved by these formulas.

**10.** Construct a rectangle whose width is 1 inch and whose length is $1\frac{1}{2}$ inches. What is its area?

**11.** Construct a parallelogram whose base is 2 inches and whose altitude is $1\frac{1}{2}$ inches. What is its area?

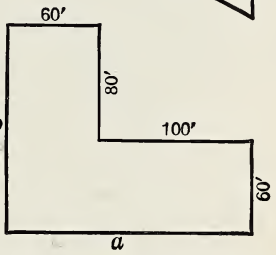
**12.** Draw a figure to the scale of $\frac{1}{2}$ inch to 10 feet to represent a playground 50 feet long and 60 feet wide.

## MIXED PROBLEMS IN MEASUREMENTS




**1.** What is the name given to the figure at the right?

**2.** Find the area of the piece of land shown in this figure.




**3.** Here is a plan of a school playground. All the angles are right angles. How long is side $a$? side $b$?

**4.** Find the perimeter of the playground.

**5.** Find the area of the playground.

**6.** Allowing $6\frac{1}{4}$ gal. to the cubic foot, what is the capacity of a tank 25 ft. long, 4 ft. wide, and 3 ft. deep?

**7.** A truck body measured 8 ft. square and 6 ft. deep. How many cords of wood will it hold?

**8.** How much greater is the area of a 7-inch square than that of a circle 7 inches in diameter?

**9.** If a wagon wheel has a diameter of 42 inches, how many times will it revolve in going $\frac{1}{4}$ mile?

**10.** Mr. Herndon wants to store 200 gallons of water. Will a cubical tank 3 feet on each side be large enough?

**11.** Find the weight of the water that fills a vat 8 ft. deep and 4 ft. by 3 ft. at the base. (1 gal. = 10 lb.)

**12.** A square plot of ground has an area of 3 acres. How much larger is it than a lot 25 rods long and 18 rods wide?

**13.** What is the perimeter of a square that has an area of 144 square inches?

***14.** Make up three problems about measurements.

### FISHING AND FARMING

In a recent year there were in British Columbia 89 establishments engaged in curing and packing fish. They employed 1,037 people and produced products worth $9,085,834.

**1.** What was the average number of people employed in these establishments? the average value of products for each establishment?

**2.** The wages paid equalled $1,062,886. What per cent of the value of the products was used to pay wages?

**3.** The pulp and paper industry employed 2,330 people and paid $3,015,228 in wages. What was the difference in the annual wage per person in the two industries?

**4.** If the total number of industrial establishments in British Columbia was 1,780, what per cent of them was engaged in curing and packing fish?

In 1933, the leading agricultural products of Alberta were: Field crops, $76,364; farm animals, $16,939; dairy products, $12,724; poultry and eggs, $2,648.

**5.** What was the total value of these products?

**6.** The value of field crops was what per cent of the total value?

**7.** What is the approximate ratio of the dairy products to the field crops?

**8.** The value of *all* products in the province was $110,705. Using round numbers correct to the nearest thousand dollars, what fractional part of the whole value was the value of the field crops?

**9.** Find the excess of farm animals over dairy products.

## THE COSTS OF RUNNING A BUSINESS

The table given below shows the record of expenses and receipts for a tea room and shop operated by the townswomen of a community for the benefit of visitors and the general public. It shows what items must be included in the costs of any business.

Find the items numbered (1), (2), (3), (4), (5), (6).

| Item | Cost | |
|---|---|---|
| Manager's salary | $1,426.24 | |
| Assistant's salary | 412.50 | |
| Rent | 300.00 | |
| Equipment | 1,188.52 | |
| Insurance | 3.55 | |
| Electricity | 418.60 | |
| Telephone | 29.26 | |
| Fuel | 105.58 | |
| Total overhead | | ————(1) |
| Groceries | 1,364.25 | |
| Milk | 390.57 | |
| Ice | 119.09 | |
| Other foods and general expenses | 796.86 | |
| Total food | | ————(2) |
| Paid to cooks and waiters | | $3,759.70 |
| Total cost | | ————(3) |
| Total sales | | 10,368.73 |
| Net gain or loss | | ————(4) |
| Per cent of gain or loss based on sales | | ————(5) |
| Per cent of gain or loss based on total cost | | ————(6) |

### CUMULATIVE TEST IV

This test contains many different kinds of examples. If you make any mistakes, practise other examples similar to those which you worked incorrectly. You should be able to complete all of these examples in *fifteen minutes.*

1. $9\frac{1}{2} + 4\frac{2}{5} + 6\frac{7}{10} =$ (*20*)
2. $16\frac{9}{10} - 15 =$ (*20*)
3. $\frac{7}{8} \times 1\frac{11}{21} \times \frac{9}{14} =$ (*24*)
4. $\frac{3}{4} \div 2\frac{7}{10} =$ (*29*)
5. $5\frac{1}{4} \div \frac{7}{12} =$ (*29*)
6. $.3 + .4 + .3 =$ (*39*)
7. $3.6 + 48 + 5.94 =$ (*39*)
8. $\$25.50 = 6\%$ of ? (*93*)
9. Express $\frac{3}{25}$ as a per cent. (*37, 78*)
10. $8.3 - 4.654 =$ (*39*)
11. $1{,}000 \times 5.3 =$ (*45*)
12. $.09 \times .05 =$ (*41*)
13. $65.3 \div 100 =$ (*45*)
14. $8.36 \div 10 =$ (*45*)
15. $25\%$ of $80 =$ (*79*)
16. $.9 =$ ? % of 4.5 (*90*)
17. Divide 18,278 by 26. (*12*)
18. What part of $\frac{1}{4}$ is $\frac{1}{8}$? (*28*)
19. What decimal part of 48 is 12? (*90*)
20. Compare 17.5 with 8.75. (*90*)
21. Change $10\frac{9}{50}$ to a decimal. (*37*)
22. Find the product of 462 and 739. (*10*)
23. Subtract 47,632 from 125,410. (*8*)
24. $6{,}694 + 3{,}676 + 3{,}759 + 2{,}595 + 4{,}457 + 4{,}679 + 3{,}369 =$ (*6*)
25. Name three kinds of triangles. (*147*)

### VOCABULARY EXERCISE

Explain the meaning of the following:

| | | | |
|---|---|---|---|
| **1.** square | **6.** formula | **11.** circumference | **16.** parallel |
| **2.** transit | **7.** rectangle | **12.** perpendicular | **17.** interest |
| **3.** graph | **8.** perimeter | **13.** compasses | **18.** angle |
| **4.** bisect | **9.** isosceles | **14.** parallelogram | **19.** discount |
| **5.** scale | **10.** bar graph | **15.** protractor | **20.** degree |

### PRACTICE TESTS IN THE FUNDAMENTALS

You should be able to find the answers to these examples and check your work in *six minutes.*

| **1.** | **2.** | **3.** | **4.** | **5.** | **6.** |
|---|---|---|---|---|---|
| 594 | 588 | 965 | 776 | 973 | 798 |
| 847 | 160 | 723 | 924 | 821 | 557 |
| 976 | 293 | 798 | 348 | 712 | 848 |
| 453 | 476 | 796 | 138 | 931 | 699 |
| 809 | 793 | 742 | 265 | 872 | 876 |
| 562 | 453 | 995 | 536 | 124 | 919 |
| 884 | 861 | 756 | 169 | 658 | 818 |

Find the answers and check your work in *four minutes.*

| | | | | |
|---|---|---|---|---|
| **1.** 9,080 | **3.** 11,900 | **5.** 3,376 | **7.** 16,575 | **9.** 12,344 |
| − 6,759 | − 9,901 | − 2,968 | − 6,778 | − 4,446 |
| **2.** 8,010 | **4.** 7,462 | **6.** 15,886 | **8.** 2,333 | **10.** 6,661 |
| − 3,584 | − 4,399 | − 5,889 | − 1,677 | − 5,892 |

Find products and check your work in *eight minutes.*

| | | |
|---|---|---|
| **1.** 490 × 849 | **4.** 465 × 9,005 | **7.** 2,500 × 7,865 |
| **2.** 796 × 708 | **5.** 807 × 625 | **8.** 4,009 × 8,574 |
| **3.** 405 × 629 | **6.** 823 × 9,080 | **9.** 7,037 × 9,642 |

You should be able to find the quotients of these examples and to check your work in *eight minutes.*

1. 1,896 ÷ 28
2. 4,285 ÷ 63
3. 10,675 ÷ 35
4. 14,416 ÷ 72
5. 52,104 ÷ 26
6. 74,370 ÷ 37
7. $113.68 ÷ 812
8. 10,330 ÷ 298
9. 38,545 ÷ 593

### PRACTICE TESTS IN FRACTIONS—VII (5 minutes)

1. $\frac{1}{15} \div \frac{1}{2} =$
2. $7\frac{3}{4} + 9\frac{1}{2} =$
3. $6\frac{1}{4} - 6\frac{1}{8} =$
4. $3\frac{2}{7} \times 2\frac{1}{3} =$
5. $4\frac{4}{5} \div 6 =$
6. $\frac{7}{12} + \frac{4}{5} =$
7. $6 \times 3\frac{3}{4} =$
8. $23\frac{1}{4} - 6\frac{2}{3} =$
9. $\frac{2}{5} + 1\frac{2}{3} =$
10. $\frac{2}{5} \times \frac{2}{3} =$
11. $7\frac{1}{8} \div \frac{5}{8} =$
12. $3\frac{1}{3} - 1\frac{3}{4} =$

### PRACTICE TESTS IN DECIMALS—VI (5 minutes)

1. .9 + .8 + .6 =
2. .85 + .24 + .46 =
3. 3.75 + 98 + .05 =
4. 86.375 − 49 =
5. 95.76 − 8.79 =
6. 38 − 19.475 =
7. .5 × 4.8 =
8. 9 × .375 =
9. .06 × 1.42 =
10. 37.5 ÷ 2.5 =
11. 9.844 ÷ .4 =
12. 1.44 ÷ .12 =
13. Change $\frac{5}{8}$ to a decimal fraction.
14. Express $14\frac{3}{4}$ as a decimal number.

### PRACTICE TESTS IN PERCENTAGE—IV (5 minutes)

1. Express the following as per cents:

   $\frac{1}{2}$; $\frac{3}{4}$; .5; .6; 1.45; .375; $1.12\frac{1}{2}$

2. Express the following as decimals:

   8%; 205%; 18%; $4\frac{1}{2}$%; $\frac{1}{5}$%; 7.5%

3. 7% of $840 =
4. 25 = ? % of 75
5. 50 = 25% of ?
6. 125% of 400 =
7. 120% of ? = 360
8. 80 = ? % of 64
9. How much less than a whole is 8% of it?
10. What number is 15% more than 160?

### VOCABULARY EXERCISE

Explain the meaning of the following:

1. geometry
2. right angle
3. protractor
4. isosceles
5. oblique
6. equilateral
7. estimate
8. diameter
9. parallel
10. approximate
11. vertex
12. acute angle
13. bisect
14. perpendicular
15. degree
16. parallelogram
17. horizontal
18. compasses
19. scale
20. diagonal
21. radius

### TOPICS FOR SPECIAL REPORTS

The topics below deal with many applications of mathematics. Select one topic and prepare a report on it.

1. Uses of geometry in architecture.
2. Uses of geometry in the designs of wall paper, linoleum, cloth, etc.
3. Uses of geometry in landscape gardening.
4. Uses of geometry in labels, copyrights, and trademarks.
5. The work of the surveyor.
6. The mathematics of the radio.
7. Methods of measuring time.
8. Famous tunnels.
9. The depths of lakes, oceans, and mines.
10. The heights of mountains and famous structures.
11. How nature uses geometry.
12. The methods used to measure distance.
13. Athletic and other records.
14. The methods used to measure weight.
15. Measuring instruments used on the furnace, the automobile, etc.

### PROBLEM SCALE III

**1.** Jack worked $6\frac{1}{2}$ hours a day for 6 days. How much did he receive if his wages were 30 cents an hour?

**2.** If 17 acres of land produce 442 bushels of grain, what is the average value of the yield an acre at \$1.40 a bushel?

**3.** A house worth \$4,785.50 was repaired at a cost of \$218.75 and was then sold for \$5,250. Find the gain.

**4.** A man has a steam heating plant in his house. Last winter he burned $16\frac{1}{2}$ tons of coal at \$9.20 a ton. How much did his fuel cost?

**5.** A farmer's wife bought $2\frac{3}{4}$ yards of table linen at 80 cents a yard and 16 yards of flannel at 55 cents a yard. She paid in butter at 50 cents a pound. How many pounds of butter did she give in exchange?

**6.** A farmer raised 25 tons of hay on a $7\frac{1}{2}$-acre field. Find the average value of the yield an acre, if the hay sold at \$18 a ton.

**7.** A farm-club boy raised 8 bales of cotton, each weighing 500 pounds. He sold the cotton for 18.5 cents a pound. How much did he receive for the cotton?

**8.** A merchant paid \$52.50 for 1,000 pounds of sugar and sold it for 6 cents a pound. How much did he gain if the cost of handling was $\frac{1}{4}$ cent a pound?

**9.** Which costs less, and how much less, a rug 9 feet by 12 feet, priced at \$21.50, or the same amount of carpet at \$2.00 a square yard?

**10.** What is the volume of a rectangular tank 6 feet long, 3 feet wide, and $2\frac{1}{2}$ feet deep?

## SECTION V

### THE MEANING OF INTEREST

When we borrow money, we pay for the use of it, just as we pay for the use of a house, a boat, or a car. The amount we pay for the use of money is determined by percentage—we pay a certain per cent of the amount we borrow.

Helen borrowed \$50 from her father. She agreed to repay the loan at the end of a year and, in addition, 6% of the \$50 for the use of the money. How much did she pay for the use of the \$50?

*Think:* 6% of \$50 = ?

Business men call the sum of money borrowed the *principal* of the loan; the money that is paid for the use of the money, the *interest;* the per cent of the principal that is paid as interest, the *rate;* the length of time for which interest is paid, the *time.* Unless otherwise specified, interest is always calculated for one year at the given *rate.*

What is the principal of Helen's loan? the interest? the rate of interest? the time?

**1.** What is the interest on \$100 for 1 year at 7%? at 8%? at $3\frac{1}{2}$%? at $4\frac{1}{2}$%?

**2.** What is the interest on \$100 for 3 years at 6% a year?

*Think:* Interest for 1 year is 6% of \$100.
Interest for 3 years is 3 times the interest for 1 year.

**3.** Find three years' interest on \$450 at 6%.

This may be done in either of the following ways:

*a*

Interest = \$450 × .06 × 3;

*b*

Interest = \$450 × $\frac{6}{100}$ × 3.

In these expressions which number represents the *principal*? Which number represents the *rate* of interest? Why can 6% be expressed as either .06 or $\frac{6}{100}$? Which number represents the *time*?

**4.** Find the interest on \$200 for 2 years at 7% a year.

| | | |
|---|---|---|
| \$200 | = | Principal |
| .07 | = | Rate |
| 14.00 | = | Interest for 1 year |
| 2 | | |
| \$28.00 | = | Interest for 2 years |

**5.** Use both of the above methods to find the interest on \$480 at 5% for 2 years.

Find the interest in each of the following for 1 year:

**6.** \$500 at 8%
**7.** \$800 at 7%
**8.** \$550 at 4%
**9.** \$650 at 5%
**10.** \$675 at 6%
**11.** \$975 at 8%
**12.** \$450 at 4½%
**13.** \$640.50 at 6%
**14.** \$250.40 at 5%
**15.** \$5,840 at 7½%

**16.** Harry borrowed \$300 with which to buy materials to build a summer camp. He repaid the loan at the end of 2 years with interest at 6%. How much interest did he pay?

**17.** Why do people charge interest for the use of money? In what way is rent for a house or garage the same as interest?

### THE INTEREST FORMULA

To find the interest for one year, we multiply the principal by the rate of interest. To find the interest for any given time, we multiply the interest for one year by the time expressed in years. This rule may be expressed more briefly as follows:

*Interest = principal × rate × time.*

A still shorter way to express the rule is the formula:

$$i = p \times r \times t, \text{ or } i = prt.$$

What does each letter in the formula represent?

**1.** Find the interest on \$400 at $4\frac{1}{2}\%$ for 3 years.

Using given numbers for the letters in the formula, we find that:

$$i = \$400 \times .045 \times 3 = \$54$$

**2.** Find the interest on \$400 at $4\%$ for 6 months ($\frac{1}{2}$ year).

$$i = \$400 \times .04 \times \tfrac{1}{2} = ?$$

The principal plus the interest is called the *amount.*

Find the interest and amount in the following:

| | Principal | Rate | Time | | Principal | Rate | Time |
|---|---|---|---|---|---|---|---|
| **3.** | \$400 | $5\%$ | 3 yr. | **11.** | \$900 | $3\frac{1}{2}\%$ | 6 mo. |
| **4.** | \$700 | $4\%$ | 4 yr. | **12.** | \$650 | $5\%$ | 1 yr. 6 mo. |
| **5.** | \$800 | $6\%$ | 3 yr. | **13.** | \$725 | $4\%$ | 2 yr. 6 mo. |
| **6.** | \$750 | $4\frac{1}{2}\%$ | $3\frac{1}{2}$ yr. | **14.** | \$500 | $2\frac{1}{2}\%$ | 3 yr. |
| **7.** | \$2,900 | $6\%$ | $2\frac{1}{2}$ yr. | **15.** | \$600 | $5\%$ | $2\frac{1}{2}$ yr. |
| **8.** | \$1,500 | $2\%$ | 6 mo. | **16.** | \$950 | $3\%$ | 6 mo. |
| **9.** | \$3,000 | $6\%$ | 4 mo. | **17.** | \$4,000 | $6\%$ | 8 mo. |
| **10.** | \$1,200 | $4\%$ | 9 mo. | **18.** | \$540 | $4\%$ | 1 yr. 4 mo. |

**19.** Find $i$ if $p$ is \$200, $r$ is $4\%$ and $t$ is 3 years.

**20.** If $p$ is \$250, $r$ is $8\%$, and $t$ is 6 months, what is $i$?

**21.** How much is $i$ if $p$ is \$300, $r$ is $2\%$, and $t$ is $1\frac{1}{4}$ years?

### INTEREST PROBLEMS

1. Find the yearly interest on \$200 at 6%.

*Think:* 6% of \$200 = ?

2. The yearly interest on a loan of \$300 was \$21. Find the rate of interest.

*Think:* \$21 = ? % of \$300.

3. The yearly interest on a loan was \$24. If the rate of interest was 5% how much was the principal?

*Think:* \$24 = 5% of the principal.
\$24 = 5% of ?

In yearly interest problems you always have three items to deal with, the principal, the rate, and the interest. If you know two of these items you can always find the third item, as shown above.

Find the missing numbers in the table below. The time in all cases is one year.

| | Principal | Rate | Interest | Amount |
|---|---|---|---|---|
| 4. | \$1,000 | 5% | ? | ? |
| 5. | \$2,000 | 4% | ? | ? |
| 6. | \$1,000 | ? | \$60 | ? |
| 7. | \$2,000 | ? | \$100 | ? |
| 8. | \$1,000 | ? | ? | \$1,040 |
| 9. | \$2,000 | ? | ? | \$2,200 |
| 10. | ? | 7% | \$210 | ? |
| 11. | ? | 4% | \$60 | ? |
| 12. | ? | 5% | \$75 | ? |
| 13. | \$2,875 | 6% | ? | ? |
| 14. | \$3,600 | ? | \$108 | ? |
| 15. | \$2,975 | ? | ? | \$3,094 |
| 16. | ? | 3% | \$174 | ? |
| 17. | \$4,800 | ? | ? | \$5,040 |

## MORE DIFFICULT INTEREST PROBLEMS

**1.** The interest on a loan of \$500 for 2 years was \$50. What was the annual rate of interest?

*Think:* Interest for 1 year = $\frac{1}{2}$ of \$50, or \$25.
\$25 = ? % of \$500.

Find the annual rate of interest in the following examples. Check your work.

| | Principal | Interest | Time | | Principal | Interest | Time |
|---|---|---|---|---|---|---|---|
| **2.** | \$300 | \$36 | 2 yr. | **8.** | \$550 | \$33 | $1\frac{1}{2}$ yr. |
| **3.** | \$400 | \$60 | 3 yr. | **9.** | \$720 | \$90 | $2\frac{1}{2}$ yr. |
| **4.** | \$500 | \$20 | 2 yr. | **10.** | \$1,000 | \$200 | 4 yr. |
| **5.** | \$600 | \$144 | 4 yr. | **11.** | \$300 | \$9 | $\frac{1}{2}$ yr. |
| **6.** | \$750 | \$90 | 3 yr. | **12.** | \$420 | \$12.60 | 6 mo. |
| **7.** | \$800 | \$80 | 4 yr. | **13.** | \$625 | \$56.25 | $1\frac{1}{2}$ yr. |

**14.** The interest on a certain loan for 2 years was \$40. The rate of interest was 4% a year. Find the principal.

*Think:* Interest for 1 year was $\frac{1}{2}$ of \$40, or \$20.
4% of ? = \$20.

Find the principal:

| | Interest | Rate | Time | | Interest | Rate | Time |
|---|---|---|---|---|---|---|---|
| **15.** | \$24 | 6% | 2 yr. | **23.** | \$300 | 4% | $1\frac{1}{2}$ yr. |
| **16.** | \$60 | 4% | 3 yr. | **24.** | \$40 | 4% | 6 mo. |
| **17.** | \$44 | 5% | 2 yr. | **25.** | \$440 | $5\frac{1}{2}$% | 2 yr. |
| **18.** | \$27 | 3% | 3 yr. | **26.** | \$48 | 8% | 3 yr. |
| **19.** | \$60 | 4% | 2 yr. | **27.** | \$75 | 6% | $2\frac{1}{2}$ yr. |
| **20.** | \$48 | 5% | 4 yr. | **28.** | \$37.50 | $2\frac{1}{2}$% | 3 yr. |
| **21.** | \$35 | 2% | $3\frac{1}{2}$ yr. | **29.** | \$24.80 | 6% | 1 yr. 4 mo. |
| **22.** | \$42 | $3\frac{1}{2}$% | 2 yr. | **30.** | \$18.60 | 4% | 2 yr. 6 mo. |

*31. Can you suggest another way to find the principal?

## REVIEW OF INTEREST

1. A farmer borrowed \$6,000. He paid interest at the rate of 5% a year. How much was his interest a year? a month?

2. How much would be his total interest in 20 years, if he repaid none of the loan during that time? How much money would he still owe the lender?

3. The interest on a loan of \$500 was \$40 a year. Find the rate of interest. Find the amount at the end of three years.

4. The unpaid interest on a loan of \$500 amounted to \$140 at the end of 4 years. Find the rate of interest.

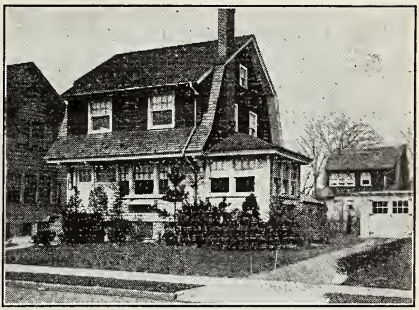
5. The yearly interest on a loan was \$30. If the rate of interest was 6%, find the principal.

6. The unpaid interest on a loan was \$480. If the time was 4 years and the rate 8%, find the principal.

Find the missing items below:

| | Principal | Rate | Time | Interest | Amount |
|---|---|---|---|---|---|
| 7. | \$400 | 5% | 2 yr. | ? | ? |
| 8. | \$600 | 7% | 6 mo. | ? | ? |
| 9. | \$750 | ? | 2 yr. | \$60 | ? |
| 10. | \$800 | ? | 3 yr. | \$120 | ? |
| 11. | \$500 | ? | 2 yr. | ? | \$540 |
| 12. | \$750 | ? | 3 yr. | ? | \$885 |
| 13. | ? | 4% | 4 yr. | \$320 | ? |
| 14. | ? | 5% | 2 yr. | \$14.80 | ? |
| 15. | \$600 | 6% | 8 mo. | ? | ? |
| 16. | \$800 | ? | 6 mo. | \$12 | ? |
| 17. | \$900 | ? | $1\frac{1}{2}$ yr. | ? | \$954 |
| 18. | ? | 6% | 2 yr. | \$360 | ? |

## THE COST OF INSURING THE HOME



Mona MacKenzie's father valued his home at \$8,000. He insured it against fire for \$6,000. If the home were damaged by fire, the insurance company would pay Mr. MacKenzie the actual amount of his loss up to \$6,000. For this protection the company charges a small *premium* of $\frac{1}{3}\%$ of the \$6,000. The company gave Mr. MacKenzie a printed contract, called a *policy*, which stated the conditions of the agreement. The \$6,000 is called the *face* of the policy.

**1.** Find the premium on \$6,000 at $\frac{1}{3}\%$ a year.

*Think:* Premium = $\frac{1}{3}\%$ of \$6,000 = ?

**2.** Three months after Mr. MacKenzie had paid the first premium, the house was damaged by fire. If the damage amounted to \$400, how many times as much as the premium was Mr. MacKenzie paid by the company?

**3.** Mr. Kelly, a neighbor, insured his \$8,000 home for $\frac{4}{5}$ of its value. Find his premium at $\frac{1}{3}\%$ a year. Why are houses usually not insured for their full value?

**4.** The premium rate on an automobile garage in which many automobiles are stored overnight is $1\frac{1}{4}\%$ a year. Why should the premium rate on a garage be greater than on a home? Do you think that the premium rate on a

home in the country would be greater or less than on the same kind of home in the city? Why?

Find the premiums on the following policies at the rate given:

| | Face | Rate | | Face | Rate |
|---|---|---|---|---|---|
| 5. | $2,000 | $\frac{1}{2}\%$ | 9. | $4,000 | $\frac{3}{8}\%$ |
| 6. | $3,000 | $\frac{1}{3}\%$ | 10. | $5,000 | $\frac{2}{5}\%$ |
| 7. | $4,000 | $\frac{1}{2}\%$ | 11. | $6,000 | $\frac{1}{3}\%$ |
| 8. | $5,000 | $\frac{1}{4}\%$ | 12. | $8,000 | $\frac{1}{4}\%$ |

## Finding the Cost of Insurance

Frequently the premium rate is stated as so many cents on a hundred dollars. If the premium rate is $.30 on $100, the premium on $6,000 may be found as follows:

$6,000 ÷ $100 = 60 hundreds of dollars.

60 × $.30 = $18, the premium on $6,000.

Policies are often issued for terms of 3 or 5 years. The average premium on such policies is usually less a year than on a one-year policy.

**1.** Mr. Jackson insured his home for $5,000. At a yearly rate of $.25 a $100, what is the amount of his premium for one year?

Find the yearly premiums on these policies:

| | Amount of Insurance | Rate per $100 | | Amount of Insurance | Rate per $100 |
|---|---|---|---|---|---|
| 2. | $4,000 | $.18 | 7. | $10,000 | $1.40 |
| 3. | $5,000 | .22 | 8. | $11,600 | 2.00 |
| 4. | $7,500 | .31 | 9. | $7,700 | 1.65 |
| 5. | $450 | .36 | 10. | $24,600 | 2.15 |
| 6. | $270 | .48 | 11. | $8,900 | .76 |

**12.** The cost of insuring a garage in the country is $.80 for each hundred dollars of insurance, and on the same

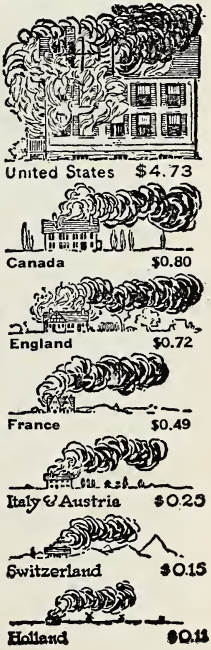
kind of garage in a near-by city it is only $.40 a hundred dollars. Find the difference in the yearly premiums on a $2,000 policy on two such garages, one in the city and one in the country. Why is there a difference in these rates? For what other reasons do premium rates differ?

**13.** The rate for a 1-year policy for insuring a house is $.30 a hundred dollars; for a 3-year policy the rate is $.75 a hundred dollars. Find the difference in the total premiums for three 1-year policies of $2,200 each and one 3-year policy for the same amount.

**14.** What is the average yearly premium paid for the 3-year policy in problem **13**? How much less is this than the yearly premium on a 1-year policy?

Find the average yearly premiums at the given rates for $100:

| | Amount of Insurance | Rate of 1-Year Policy | Rate of 3-Year Policy | Rate of 5-Year Policy |
|---|---|---|---|---|
| **15.** | $3,000.. | $.40 | $1.00 | $1.60 |
| **16.** | $4,800.. | .60 | 1.50 | 2.40 |
| **17.** | $11,000. | .90 | 2.25 | 3.60 |




*__18.__ At the right is a series of drawings which show the average fire loss per person per year in several countries. Find the population of each country and compute its annual fire loss.

*__19.__ What is life insurance? automobile insurance? accident insurance? Discuss with your parents the value of insurance.

### CONSTRUCTION PROBLEMS

**1.** With your protractor draw an angle of 40°. Now draw a straight line $AB$ and label a point $P$ on the line. With compasses construct an angle of 40° at $P$.

**2.** With compasses, but without protractor, construct a right angle; an angle of 60°. Check the accuracy of your work with a protractor.

**3.** Draw an obtuse angle. With compasses construct an angle equal to it.

**4.** Construct a rectangle with a length of 2 inches and a width of $1\frac{1}{2}$ inches.

**5.** Construct an equilateral triangle.

**6.** Construct an isosceles triangle.

**7.** Draw a scalene triangle. Bisect one of its angles.

**8.** Construct two parallel lines.

**9.** Make a copy of a given triangle.

**10.** Construct an angle equal to a given angle.

**11.** Draw a line. Bisect the line.

**12.** Construct a right angle.

**13.** Make a scale drawing of a $10' \times 12'$ room, using the scale of $\frac{1}{2}$ inch for 1 foot.

**14.** Construct an equilateral triangle 2 inches on a side.

### VOCABULARY EXERCISE

Explain the meaning of the following:

| | | |
|---|---|---|
| **1.** geometry | **6.** diameter | **11.** degree |
| **2.** right angle | **7.** parallel | **12.** parallelogram |
| **3.** protractor | **8.** approximate | **13.** horizontal |
| **4.** isosceles | **9.** vertex | **14.** compasses |
| **5.** oblique | **10.** acute angle | **15.** scale |

## PRACTICE TESTS

Compare your first scores with the scores on the first trials of previous practice tests. Practise until you can work the examples in each test correctly in the time allowed.

### PRACTICE TEST IN FRACTIONS—VIII (5 minutes)

1. $5\frac{5}{6} + 9\frac{5}{6} =$
2. $8\frac{1}{8} - 1\frac{1}{2} =$
3. $\frac{5}{6} \times \frac{3}{4} =$
4. $5 \div \frac{2}{3} =$
5. $1\frac{1}{4} + 3\frac{7}{12} =$
6. $4\frac{2}{3} \div \frac{2}{3} =$
7. $1\frac{3}{8} \div \frac{3}{10} =$
8. $3\frac{1}{6} \times 4 =$
9. $5\frac{3}{5} \div 2 =$
10. $6 - 5\frac{2}{3} =$
11. $7\frac{1}{2} \times \frac{2}{5} =$
12. $6\frac{2}{3} + 4\frac{3}{4} =$

### PRACTICE TEST IN DECIMALS—VII (5 minutes)

1. $4.1 + 5.7 + 8.5 =$
2. $9.46 + 6.52 + 8.91 =$
3. $.64 + 97.40 + 16.28 =$
4. $84.7 - 25.9 =$
5. $47.396 - 42.306 =$
6. $9 - 3.748 =$
7. $3.06 \times .5 =$
8. $9 \times 3.7 =$
9. $.08 \times 5.84 =$
10. $6.55 \div 5 =$
11. $5.985 \div .9 =$
12. $12.221 \div 1.1 =$
13. Change $\frac{5}{6}$ to thousandths.
14. Change 7.375 to a mixed number.

### PRACTICE TEST IN PERCENTAGE—V (5 minutes)

1. Express the following as per cents:

   .04; 1.375; $\frac{1}{5}$; 2.1; $1.12\frac{1}{2}$; .125.

2. Express the following as decimals:

   16.5%; 118%; .5%; $6\frac{1}{4}$%; 3%; 300%.

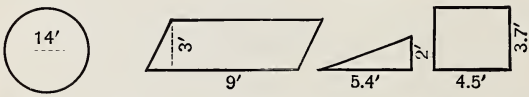
3. 6% of \$480 =
4. 480 = —% of 600
5. 8% of ? = \$51.20?
6. $133\frac{1}{3}$% of \$648 =
7. 720 = 120% of ?
8. ?% of 750 = 900
9. How much more than the whole is 106% of it?
10. What number is 200% of 36?

## CUMULATIVE TEST V

If you make any mistakes in this test, practise other examples similar to those which you worked incorrectly. Use the Index to find the needed practice material.

1. $8\frac{1}{2} + 4\frac{2}{3} + 6\frac{1}{4} =$ (*20*)
2. $18\frac{1}{3} - 15\frac{5}{6} =$ (*20*)
3. $\frac{9}{10} \times \frac{4}{15} \times 6\frac{2}{3} =$ (*24*)
4. $2\frac{1}{2} \div 7\frac{1}{2} =$ (*29*)
5. $\frac{7}{8} \div \frac{3}{4} =$ (*29*)
6. $.6 + .7 + .9 =$ (*39*)
7. $4.1 + 85 + .375 =$ (*39*)
8. $7.5 - 4.25 =$ (*39*)
9. $100 \times 47.6 =$ (*45*)
10. $.04 \times .07 =$ (*41*)
11. $67.8 \div 100 =$ (*45*)
12. $8.57 \div 10 =$ (*45*)
13. 15% of 6.4 = (*82*)
14. 120% of 86 = (*84*)
15. $\frac{3}{4}$ = ? % of $1\frac{1}{2}$. (*90*)
16. Change $\frac{7}{16}$ to a decimal. (*37*)
17. \$14.40 = 12% of ? (*93*)
18. Divide 48,596 by 359. (*12*)
19. What is the ratio of $2\frac{1}{2}$ to 10? (*88*)
20. Express .6 as per cent. (*78*)
21. Draw an angle of 45° in two different ways. (*140, 149*)
22. Draw two lines each $4\frac{1}{2}$ inches long. Bisect the first line by one method, the second line by another. (*146*)
23. Find the area of each of the following:

(*166*) (*155*) (*162*) (*157*)



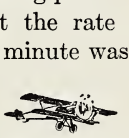

24. Find the volume of a rectangular solid, 3 feet by 5 feet by $7\frac{1}{2}$ feet. (*169*)
25. If $A = 75$ square feet, and $w = 5$ feet, what is $l$? (*155*)
26. What is the circumference of a circle whose diameter is 42 inches? (*164*)
27. Draw a circle whose radius is $1\frac{1}{2}$ inches.
28. Find the per cent reduction on a \$25 bicycle sold for \$21. (*106*)

### PROBLEM SCALE IV

**1.** Coal which usually sells at \$14.75 a ton was on sale at \$13.50 a ton. How much would be saved by buying 12 tons of coal at the sale price?

**2.** A dealer sold a truck that cost him \$1,800 at a discount of 20%. What was the selling price?

**3.** An airplane recently flew at the rate of 268.38 miles an hour. How many miles a minute was this?



**4.** How many minutes longer than 8 periods of $\frac{3}{4}$ of an hour each are 7 periods of 55 minutes each?

**5.** Find the interest on \$250 for 2 years at 4%.

**6.** A dairy farm sold the following quantities of milk in August: first week, 4,010 pounds; second week, 3,750 pounds; third week, 3,990 pounds; fourth week, 3,800 pounds. How much was received for the milk at \$2.40 a hundred pounds?

**7.** A real estate agent sold a house for \$7,500. If his commission is 4% on the first \$1,000, and 3% on the rest, how much is his total commission?

**8.** An automobilist used 8 gallons of gasoline in making a trip of 100 miles. Find the cost of the gasoline a mile if the gasoline cost 20 cents a gallon.

**9.** The clothing in a men's furnishings store was valued at \$5,400. After being damaged by fire the stock of clothing was valued at \$4,050. What was the per cent of loss?

**10.** A man borrowed \$850 for 3 years at $7\frac{1}{2}$%. How much did he owe at the end of the 3 years?

## SECTION VI

### HOW TO READ DOT MAPS

This dot map shows the distribution of wheat in North and South America. Maps like this give much information at a glance.

**1.** If there were a dot for each thousand acres, would the number of dots be larger or smaller? how much?

**2.** What parts of these continents produce the most wheat? How can you tell from the map? How do you know that there is not much wheat in the central part of South America.

**3.** Is there more wheat per square mile in Mexico than in Canada?

**4.** In what part of Canada is the most wheat raised?

***5.** If you were asked to make a dot map, showing the distribution of population in your province, how many dots would you make, allowing one dot for each 2,000 people?

***6.** Try to find other illustrations of dot maps, and be ready to explain them to the class.

### CHARTING DATES IN HISTORY

One day Miss Andrews showed the class in history a very interesting way of charting the years in which some of the important events in history have occurred. This is the method she used. She drew a line on the blackboard and labelled it thus:

A. D. 1 A. D. 2000

**1.** What does A.D. mean? What does B.C. mean? A.D. is always placed before the figures; B.C. is always placed after them.

**2.** Miss Andrews asked the class where the year A.D. 1000 falls on the line.

**3.** Where does the year A.D. 1500 fall on the line? the year 1750?

**4.** On the line above, how would you indicate periods of 100 years each? How many such periods are there?

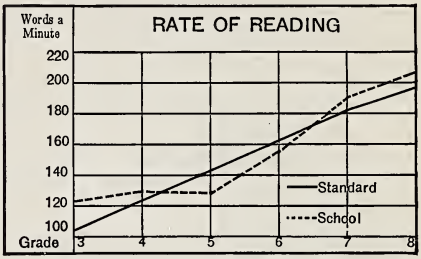
**5.** Draw a vertical line 5 inches in length. Label the lower end of it A.D. 1. Label the top end of the line A.D. 2000. Indicate the 100-year intervals. Indicate on this line where the date of the discovery of America falls; the present year?

**6.** Draw a vertical line 9 inches in length. Label one end of the line 1650 and the other end 1950. Indicate on the line the position of six important dates in Canadian history.

**7.** Historians say that recorded history begins about the year 5000 B.C. Draw a line 10 inches in length. Label one end of it 5000 B.C. and the other end A.D. 2000. On this line indicate the period of time since the Discovery of America.

## SCHOOL GRAPHS

**Silent-reading graph.** A principal gave the children in his school a test to find how rapidly they could read. He knew how rapidly they ought to read. After the papers had been graded, he made a line graph to show how well the pupils read and how well they should read. This is the graph.




**1.** The graph contains two lines. Which line shows the score for the entire school?

**2.** Which line shows how well the pupils in the classes should read?

**3.** Which grades had scores above the standard? What does *standard* mean?

**4.** Which grades read less rapidly than the standard rate of reading?

**5.** What was the average rate for pupils in each grade?

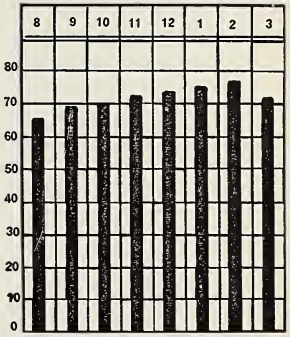
**6.** Later the principal gave another reading test and found the average score for each class. He then drew a graph of these scores. Draw the graph containing the standards and the scores as given in the table below:

| Grade..... | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|
| Score..... | 140 | 160 | 160 | 180 | 210 | 200 |

**7.** Were the scores of the second test as good as those of the first test? Which grades made better scores?

## TEMPERATURE GRAPHS

This graph shows the temperature changes during a certain school day.




**1.** What was the temperature at 8 o'clock?

**2.** What was the temperature at 9 o'clock? Notice that the bar, 9 o'clock, ends between 60° and 70°. Is the temperature 62°, 65°, 68°, 69°, or 70°?

**3.** What is the approximate temperature for each hour after 9 o'clock?

**4.** Draw a graph for the following temperatures:

| Time..... | 8 A.M. | 9 A.M. | 10 A.M. | 11 A.M. | 12 M. | 1 P.M. | 2 P.M. |
|---|---|---|---|---|---|---|---|
| Temperature | 45° | 48° | 49° | 54° | 55° | 60° | 57° |

**5.** What number is at the top of your scale? Why do graphs have scales?

**6.** What is the scale in the graph on page 196?

**7.** Draw a temperature chart for your own locality for a certain day.

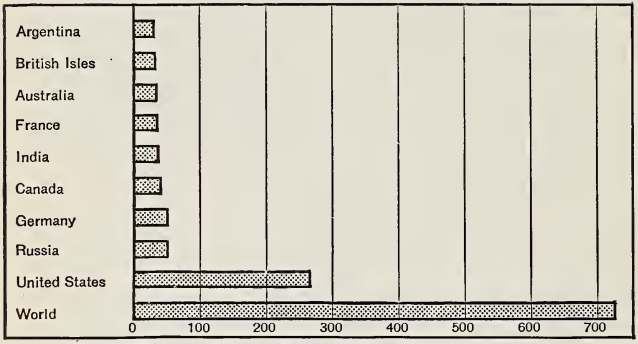
***8.** The table below shows the average temperatures for three cities for each of the first six months of one year. Draw graphs showing the changes in temperature.

| City | Jan. | Feb. | Mar. | Apr. | May | June |
|---|---|---|---|---|---|---|
| Victoria..... | 40° | 42° | 44° | 49° | 54° | 56° |
| Edmonton..... | 6° | 11° | 23° | 41° | 51° | 57° |
| Dawson City..... | −24° | −14° | 3° | 28° | 48° | 58° |

### RAILROAD MILEAGE OF IMPORTANT COUNTRIES

When bar graphs are used to represent large numbers, the results pictured are only approximate; this is another way of approximating answers.

This bar graph compares certain countries with respect to the number of miles of railroads they have. You cannot tell from the graph exactly how many miles a country has, but you can estimate the mileage closely enough.




**This graph is scaled in thousands of miles. Read 100 as 100,000.**

**1.** Express in round numbers the railroad mileage of the world. Is it nearer 700,000 or 800,000?

**2.** About how many miles of railroad are there in each of the countries listed in the graph?

**3.** Does the United States have as much as half of the railroad mileage of the world?

**4.** How much more is the approximate railroad mileage in the United States than in Russia?

**5.** What per cent of the railroad mileage of Canada is the mileage of Russia?

### PRACTICE IN MAKING GRAPHS

The exercises below contain interesting facts which you are to graph. Use cross-section paper if possible. Choose the scale you will use; that is, decide how much each space will represent in your graph. Arrange the items to be graphed in order of their size. Give a title to each graph.

**1.** Make a bar graph showing the length of each of the Great Lakes. Decide whether one interval on the scale is to represent 5 miles, 10 miles, or 20 miles.

| Lake | Length | Width | Greatest Depth | Height above Sea Level |
|---|---|---|---|---|
| Superior | 350 mi. | 160 mi. | 1180 ft. | 602 ft. |
| Michigan | 307 mi. | 118 mi. | 870 ft. | 582 ft. |
| Huron | 206 mi. | 101 mi. | 750 ft. | 582 ft. |
| Erie | 241 mi. | 57 mi. | 210 ft. | 573 ft. |
| Ontario | 193 mi. | 53 mi. | 738 ft. | 247 ft. |

**2.** Make a bar graph showing the width of the lakes; their depth.

**3.** Make either a bar graph or a line graph showing the heights of the lakes above sea level.

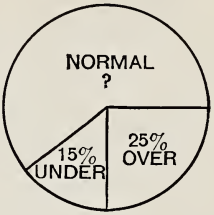
**4.** Make a bar graph showing the following facts about the increase in mileage of Canadian railroads:

| | | | |
|---|---|---|---|
| 1861 | 2,146 mi. | 1901 | 18,140 mi. |
| 1871 | 2,695 mi. | 1911 | 25,400 mi. |
| 1881 | 7,331 mi. | 1921 | 39,363 mi. |
| 1891 | 13,838 mi. | 1931 | 42,308 mi. |

**5.** Make a graph showing the number of pupils enrolled in each grade of your school.

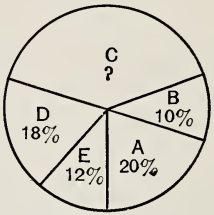
## CIRCLE GRAPHS

**How to read a circle graph.** A circle graph may be used whenever one wishes to represent a whole divided into fractional or per cent parts.



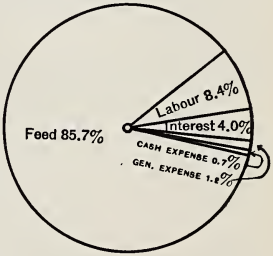

**1.** What does this circle graph show about the weights of pupils in a class? What does the whole circle represent? What per cent of the class were of normal weight?

**2.** Draw a circle graph showing 25%, 50%, and 25%.




**3.** What was the distribution of marks in the class, as represented in the circle graph at the right? What per cent does the whole circle represent?

**4.** What per cent of the class received a grade of C?



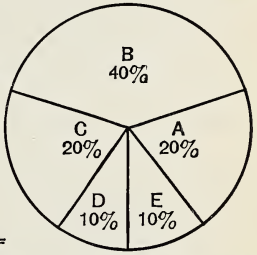

**5.** This graph shows the different items in the cost of producing pork. Name each item. Which is the largest in per cent? Which is the smallest? How many per cent does the whole circle represent?

**6.** What per cent of the total cost were the expenses, exclusive of those for feed?

**7.** The total cost of raising some hogs was $2,250. What part of this cost is allowed for the cost of feed? for labour? for interest? for cash expenses?

**How to construct a circle graph.** Miss Johnson made a table showing the distribution of mathematics marks for her class. She then made a circle graph to show these facts to the class. Here are her table and graph.

| Marks | Number of Pupils | Per Cent |
|---|---|---|
| A | 8 | 20 |
| B | 16 | 40 |
| C | 8 | 20 |
| D | 4 | 10 |
| E | 4 | 10 |




**1.** What per cent of the pupils received *A*? *B*? *C*? *D*? *E*?

**2.** How many angles did Miss Johnson draw at the center of the circle? What determines the sizes of the angles?

**3.** Which angle is the largest? Which is the smallest?

**4.** What fractional part of the group received each mark?

**5.** Since there are 360° at the center, the size of the angle to represent those receiving *A* may be found by taking 20%, or $\frac{1}{5}$ of 360°. The angle at the center representing *A* is therefore 72°. How many degrees should there be in the angle for *B*? for *C*? for *D*? for *E*?

**6.** Measure the angles in the graph Miss Johnson drew to see if they are correctly drawn.

**7.** This table shows how Miss Johnson's pupils were marked in spelling. Copy the table, find the per cent distribution of the marks, and the degrees.

| | Number | Per Cent | Degrees |
|---|---|---|---|
| *A* | 10 | ? | ? |
| *B* | 20 | ? | ? |
| *C* | 5 | ? | ? |
| *D* | 3 | ? | ? |
| *E* | 2 | ? | ? |

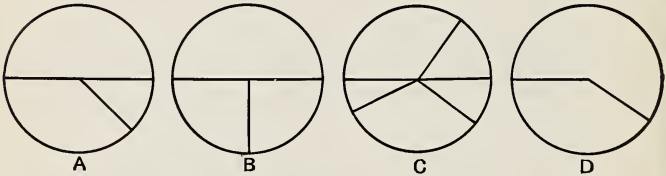
**8.** After completing the table, draw a circle graph using the facts you have found.

| Place | Time, Hours | Per Cent |
|---|---|---|
| At home .... | $5\frac{3}{4}$ | ? |
| On street car | $2\frac{1}{2}$ | ? |
| In library ... | $5\frac{1}{4}$ | ? |
| In study hall | $4\frac{2}{4}$ | ? |

**9.** Harry kept the record at the right of the amount of time he studied during a week and of the places in which he studied. Draw a circle graph to show the facts.

**10.** Mr. Smith found that of every hundred eggs he put into an incubator, 5% were sterile, 15% did not hatch, and 80% hatched. Show these facts by a circle graph.

**11.** Which circle represents the facts in each of the following statements?




*a.* Forty per cent of the pupils in a class are boys, and the remainder are girls.

*b.* In a sixth-grade class, $\frac{1}{2}$ of the children were neither absent nor tardy during the year, $\frac{3}{8}$ were absent but not tardy, and $\frac{1}{8}$ were tardy but not absent.

*c.* Fifty per cent of the pupils were normal in weight, 25% were underweight, and 25% overweight.

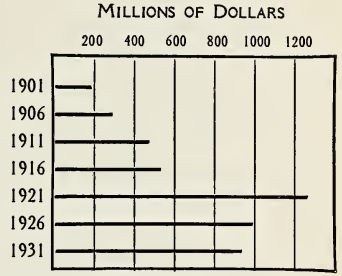
*d.* In a recent year the United States contributed 36% of the value of all minerals produced in the world, Germany 15%, Great Britain 11%, Russia 5%, Canada 10%, and the rest of the world, 23%.

## HOW TO PICTURE LARGE NUMBERS

Bar graphs and line graphs are frequently used to represent large numbers.

**1.** Estimate the value of the imports of Canada for each of the years shown in the graph.

Each interval in the scale represents 200 millions of dollars. Is the value of imports in 1901 nearer 200 than 300 million?



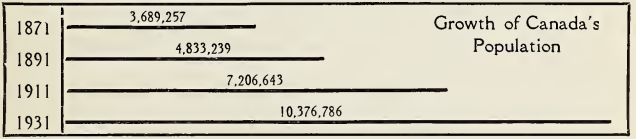

**2.** Make a similar graph, picturing the value of the exports of Canada for the years given below:

| | DOLLARS | | DOLLARS |
|---|---|---|---|
| 1901 | 178 million | 1916 | 742 million |
| 1906 | 235 million | 1921 | 1,189 million |
| 1911 | 274 million | 1926 | 1,315 million |
| | | 1931 | 800 million |

**3.** If a $\frac{1}{2}$ inch represents 10 feet in a line, how long a line will represent 100 feet? 50 feet? 120 feet? 150 feet?

**4.** If a half inch represents 5,000,000, how large a line will you draw to represent 10,000,000? 20,000,000?

**5.** Make a copy of the following graph, allowing 1 inch to represent 2,000,000.



## USING GRAPHS IN INDIVIDUAL PROJECTS

You have learned that graphs are used for a great variety of purposes. They occur in books, newspapers, magazines, and bulletins; they are used in schools, in business, and in most of the trades. People who have to construct graphs must know what kind of graph is best for a particular purpose.

Below are given ten topics that might be shown in graphic form. Think of the kinds of graphs you have been studying, and decide which kind is best for each topic.

Now select a topic in which you are interested, secure the necessary facts about it, and represent these facts by a graph.

**1.** The membership in some of the school clubs.

**2.** The amounts deposited by classes in the school savings bank.

**3.** Your expenditures each week for a month.

**4.** The amount earned each week for a month.

**5.** The daily attendance record of your class for a week.

**6.** The class scores on a test.

**7.** The average rainfall by months for the province in which you live.

**8.** The population of your province and some of the neighbouring provinces.

**9.** The variations in temperature for a week.

**10.** The number of copies of the school newspaper sold during a month.

Make up a set of rules that you think should be followed in the construction of graphs.

**1.** Draw a bar graph that will illustrate these industries of Manitoba:

| | | | |
|---|---|---|---|
| Field crops | $33,188 | Dairy products | $10,796 |
| Farm animals | 6,308 | Poultry and eggs | 2,207 |

**2.** The total agricultural revenue of Saskatchewan in 1933 was $106,417. Of this amount $75,767 was received for field crops. What per cent was due to field crops?

**3.** How much greater in value than the field crops of Manitoba were the field crops of Saskatchewan in that year?

**4.** The total mineral production of Canada in 1932 amounted to $191,228,225. About 25.6% of this was in fuel. What was the value of the fuel produced?

**5.** Draw a circle graph that will picture the forest products of Canada in 1932:

| | | | |
|---|---|---|---|
| Logs and bolts | $18,000,000 | Hewn railway ties | $1,000,000 |
| Pulp wood | 30,000,000 | Fuel | 36,000,000 |

All other products, $5,000,000

**6.** What per cent of the total was each of the above items?

**7.** Among the ten leading industries of Alberta in 1932 there were 154 sawmills, 103 bread and bakery products establishments, 103 butter and cheese factories, 79 flour and feed mills, and 84 printing and publishing plants.

***a.*** Draw a bar graph that will picture those facts.

***b.*** The total number of establishments was 683. The number of sawmills was what per cent of the total? Flour and feed mills were what per cent?

***c.*** The 683 establishments employed 7,846 people. What was the average number of people per establishment?

## VOCABULARY TESTS

In the sets below are the important words in the vo
cabulary of mathematics that you have learned.

Explain the meaning of each term in the following sets

### Set I

1. account
2. acute
3. bisect
4. horizontal
5. approximate
6. bar graph
7. horizontal bar graph
8. parallelogram
9. average

### Set II

1. bill
2. area
3. discount
4. formula
5. budget
6. kilowatt hour
7. angle
8. circumference
9. obtuse

### Set III

1. gross proceeds
2. perpendicular
3. commission
4. protractor
5. depreciation
6. volume
7. compasses
8. diameter
9. vertical

### Set IV

1. scale
2. cubic foot
3. right angle
4. circle graph
5. receipt
6. interest
7. vertical bar graph
8. rectangle
9. trade discount

### Set V

1. pictograph
2. radius
3. standard
4. parallel
5. inventory
6. invoice
7. hexagon
8. scalene
9. overhead

### Set VI

1. per cent
2. perimeter
3. ratio
4. net proceeds
5. profit
6. insurance
7. arc
8. round numbers
9. list price

### Set VII

. premium
. denominator
. vertex

4. diagonal
5. altitude
6. capacity

7. retail
8. wholesale
9. denominate number

### Set VIII

. meter
. kilowatt
. maturity

4. promissory note
5. net profit
6. margin

7. check *or* cheque
8. trade discount
9. invert

## CUMULATIVE TEST VI

This test contains many different kinds of examples. Practise on examples of your own similar to those you have incorrect. You should be able to work all of these examples correctly in *fifteen minutes.*

1. $7\frac{3}{8} + 5\frac{3}{5} + 2\frac{7}{8} =$ (*20*)
2. $14 - 13\frac{1}{10} =$ (*20*)
3. $\frac{3}{5} \times 6 \times 1\frac{1}{4} =$ (*24*)
4. $\frac{9}{10} \div 1\frac{1}{5} =$ (*29*)
5. $6\frac{7}{8} \div 3\frac{1}{2} =$ (*29*)
6. $.8 + .5 + .9 =$ (*39*)
7. $.75 + 8.1 + 16.259 =$ (*39*)
8. $9.5 - .375 =$ (*39*)
9. $6 \times .05 =$ (*41*)
10. $.05 \times 2.2 =$ (*41*)
11. $625 \div .25 =$ (*48*)
12. $.875 \div 10 =$ (*45*)
13. 15% of \$360 = (*79*)
14. $\frac{1}{2}$ = —% of $1\frac{1}{4}$. (*90*)
5. What decimal part of 36 is 10? (*90*)
6. \$1.80 = 4% of ——. (*93*)
7. Divide 68,482 by 97. (*12*)
8. Express $\frac{17}{20}$ as a per cent. (*78*)
9. What part of $\frac{1}{5}$ is $\frac{1}{10}$? (*28*)
0. Compare 2.5 and 1.75. (*90*)
1. Change $5\frac{3}{20}$ to a decimal. (*37*)
2. Find the product of 584 and 697. (*10*)
3. Subtract 57,968 from 91,010. (*8*)
4. Add 8,964; 9,785; 9,869; 5,764; and 2,798. (*6*)
5. A right angle contains .... degrees. (*128*)

## SHORT REVIEW UNITS

Find the missing numbers:

| | Principal | Rate | Time | Interest | Amount |
|---|---|---|---|---|---|
| 1. | $450 | 5% | $3\frac{1}{2}$ yr. | ? | ? |
| 2. | $500 | ? | 6 mo. | $25 | ? |
| 3. | ? | 8% | 1 yr. | $32 | ? |

Find the missing numbers in each of the following:

| | Total Sales | Rate of Commission | Commission | Other Expenses | Net Proceeds |
|---|---|---|---|---|---|
| 4. | $1,000 | 2% | ? | $4.75 | ? |
| 5. | $4,200 | ? | $126 | $15.90 | ? |
| 6. | ? | $2\frac{1}{2}$% | $250 | $8.78 | ? |

Find the missing numbers below:

| | Marked Price | Rate of Discount | Discount | Selling Price |
|---|---|---|---|---|
| 7. | $8.00 | 20% | ? | ? |
| 8. | ? | $12\frac{1}{2}$% | $200 | ? |
| 9. | $84.00 | ? | $3.36 | ? |

Find the per cent of profit based on the selling price:

| | Cost to Dealer | Overhead | Total Cost | Selling Price | Net Profit | Rate of Profit |
|---|---|---|---|---|---|---|
| 10. | $4.80 | $1.50 | ? | $7.00 | ? | ? |
| 11. | $25.40 | $10.60 | ? | $40.00 | ? | ? |
| 12. | $38.24 | $7.51 | ? | $60.00 | ? | ? |

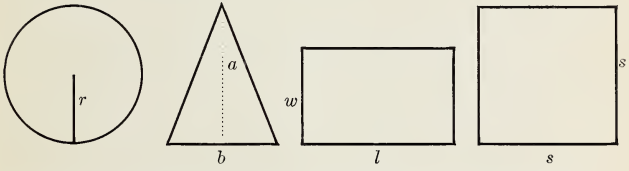
Find the missing numbers. Base rate on the cost.

| | Selling Price | Cost | Gain or Loss | Rate |
|---|---|---|---|---|
| 13. | $8.00 | $7.20 | ? | ? |
| 14. | ? | $12.00 | ? | 20% gain |
| 15. | ? | ? | $2.40 loss | 10% |

## SECTION VII

### THE MEANING OF GENERAL NUMBERS

You have learned some of the important formulas of mathematics. Give the formula to use for finding the areas of the following surfaces:




Explain what each letter in the formulas represent.

In mathematics we call letters like $r$, $a$, $b$, and $s$, *general numbers* because they do not represent any particular number. For example, in the formula, $A = lw$, $l$ represents a side of any given length, and $w$ represents a side of any given width.

The formula, $A = lw$, means: To find the length of any rectangle, multiply the length by the width, using numbers of the same value.

The area of a rectangle, 4 feet long and 3 feet wide, is $4 \times 3$, or 12 square feet. Here we substitute values for the letters in the formula and multiply.

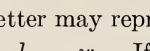
General numbers can be added, subtracted, multiplied, and divided. You will learn how in the lessons that follow.

### USING LETTERS TO REPRESENT LINES

A letter may represent the length of a line segment.

**1.** $l \mid w$ If one part of the line is represented by $l$ and the other part by $w$, the whole line equals the sum of the two parts or $l + w$.

**2.** $a \mid b \mid c$ State the length of the line.

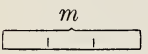
**3.** 

State the difference between $a$ and $b$.

**4.** $a \mid a \mid a$ This line is made up of three equal segments. Their sum is $a + a + a$ or $3\,a$. When the parts of a line are equal the whole length may be found by multiplying one part by the number of parts $3 \times a = 3\,a$.

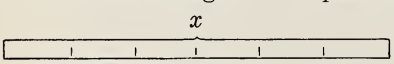
**5.** $b \mid b \mid b \mid b$ State the length of this line.

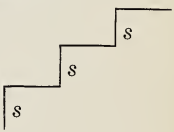
**6.** $a \mid a \mid b$ State the length of this line.

**7.** 

The whole line, $m$, is divided into three equal parts. The length of each part is $\frac{m}{3}$.

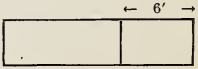
**8.** What is the length of one part of this line?




**9.** An architect expresses the height of a step as $s$. Find the height of 3 steps.

**10.** A carpenter has a board $l$ feet long. After he saws off 6 feet, how long is the board?

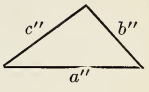



**11.** A telephone pole $h$ feet tall is divided into 4 parts. What is the length of each part?

### ADDING GENERAL NUMBERS

To find the perimeter of any triangle you must find the sum of the lengths of its sides.

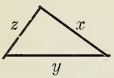
**1.** How long is the base of the triangle at the right? How long is its shortest side? Point to the side that is $c$ inches in length.

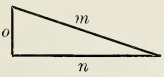


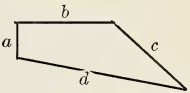

**2.** Find the perimeter of the triangle shown above.

*Think:* Perimeter equals the sum of the lengths of the three sides = $a$ in. + $b$ in. + $c$ in. or $(a + b + c)$ in.

**3.** Find the perimeters of the following figures:



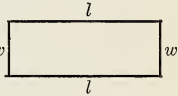

**4.** Find the perimeter of the isosceles triangle at the right.

*Think:* Perimeter = $s + s + b$

$s + s = 2\ s$.

Therefore the perimeter is equal to $2\ s + b$.

**5.** Find the perimeters of the following:




Jack and Harold had some rabbits. If we say that Jack had $x$ rabbits and that Harold had $y$ rabbits we can say that together the boys had $(x + y)$ rabbits.

**6.** If Arthur has $a$ cents and Bob has $2\ a$ cents, how many cents do they have together?

**7.** $l + l + l =$

**8.** $a + a + 2\ a =$

**9.** $w + w + l =$

**10.** $w + w + l + l =$

**11.** $a + 2\ a + b =$

**12.** $3\ a + 4\ a + x =$

### USING GENERAL NUMBERS

**1.** If I say that a boy has $c$ cents, what do I mean?

**2.** If I have 10 cents and earn 2 cents more, I can say that I have $10¢ + 2¢$, or $12¢$. If I have $c$ cents and earn 2 cents more, I can say that I have $(c + 2)$ cents. Write an expression, showing that I have 6 cents more than $c$ cents; 10 cents more than $c$ cents; 15 cents more than $a$ cents.

**3.** If the cost of an article is $a$ dollars and the gain is $b$ dollars, find the selling price.

*Think:* Selling price = cost + gain.
Selling price = $(a + b)$ dollars.

**4.** If the cost of an article is $b$ dollars and the gain is $x$ dollars, find the selling price.

**5.** I have $x$ dollars and earn $y$ more dollars. How many dollars do I have in all?

**6.** In June a boy weighed $p$ pounds. During the summer he gained $n$ pounds. Find his weight at the end of the summer.

**7.** I borrowed $a$ dollars. When I repaid the loan the interest was $i$ dollars. Find the amount I repaid.

**8.** I bought a hat at a sale for $s$ dollars. The reduction from the regular price was $r$ dollars. Find the regular price of the hat.

**9.** Each side of a square is $n$ inches. Find the perimeter of the square.

**10.** A grocer paid $x$ dollars for some potatoes and sold them for a dollar more than he paid for them. How much did he receive for the potatoes?

**11.** Find the perimeter of a triangle $t''$ on each side.

### SUBTRACTING GENERAL NUMBERS

**1.** If a grocer pays \$1.20 a bushel and sells them at a loss of \$.10 a bushel, find the selling price.

**2.** If a grocer pays $x$ cents a pound for butter and sells at a loss of 4 cents a pound, find the selling price a pound.

*Think:* Selling price = cost − loss.
Selling price = $(x - 4)$ cents.

**3.** If a grocer pays $x$ cents a pound for butter and sells it at a loss of $y$ cents a pound, find the selling price.

**4.** Find the selling price of a pair of shoes sold at a loss of $b$ dollars, if the cost was $a$ dollars.

**5.** An agent sold a house for $m$ dollars. His commission was $c$ dollars. Find the net proceeds.

**6.** The amount of a loan was $l$ dollars. The interest was $i$ dollars. Find the principal.

**7.** A grocer paid $d$ dollars for some apples and sold them for $s$ dollars. Find the gain.

**8.** The amount of a loan was $a$ dollars. The principal was $p$ dollars. Find the interest.

**9.** The regular price of a hat was $d$ dollars. It was sold during a sale for $s$ dollars. Find the reduction.

**10.** A piano regularly sold for $p$ dollars was sold at a reduction of $r$ dollars. Find the selling price.

**11.** A rectangle is $l$ feet long and $w$ feet wide. Find the difference between its length and width.

**12.** If $n$ represents a number, how much is 5 less than the number? $a$ less than the number? $x$ less than the number?

### MULTIPLYING GENERAL NUMBERS

To find the area of a rectangle 4 feet long and 3 feet wide, you multiply 4 by 3, which gives 12, the number of square feet in the area of the rectangle.

**1.** In the formula, $A = lw$, what does the $l$ represent? the $w$? What does $lw$ represent? $l$ and $w$ are both general numbers. When general numbers are multiplied, the $\times$ sign is omitted. $lw$ means $l \times w$; $4\,l$ means $4 \times l$.

**2.** Find the area of a rectangle $x$ ft. long and $y$ ft. wide.

*Think:* Area = length $\times$ width

Area = $x \times y$, or $xy$

**3.** Find the area of a rectangle $a$ feet long and $c$ feet wide.

**4.** Find the area of a parallelogram having a base of $x$ feet and an altitude of $a$ feet.

**5.** If a merchant sells $a$ coats at $d$ dollars each, how much does he receive for all of the coats?

**6.** A farmer sold $s$ sheep at an average price of $d$ dollars apiece. How much did he receive for the sheep?

**7.** If sheep weigh on the average $p$ pounds, find the weight of 4 sheep; 12 sheep; $s$ sheep; $x$ sheep.

**8.** If $m$ bales of cotton weigh $t$ pounds each, express the total weight of the cotton.

**9.** Find the volume of a tank $x$ feet long, $y$ feet wide, and $z$ feet deep.

**10.** If a square is $x$ feet long, what is its perimeter?

**11.** A rectangle is $x$ feet long and $y$ feet wide. Find its perimeter.

**12.** A triangle has a base of $x$ feet and an altitude of $a$ feet. Find its area.

### DIVIDING GENERAL NUMBERS

**1.** If a grocer pays \$16 for 10 boxes of oranges, how much does he pay for one box?

The division may be expressed in three ways:

$\$16 \div 10 =$ $\qquad 10\overline{)\$16} \qquad \frac{16}{10}$

**2.** If a grocer pays $x$ dollars for 10 boxes of oranges, how much does he pay for one box?

In division of general numbers, the division is expressed in the fractional form.

$x$ divided by 10 is written: $\frac{x}{10}$

**3.** If a grocer pays $x$ dollars for $y$ boxes of oranges, how much does he pay for one box?

You divide the cost, $x$, by the number of boxes, $y$; or $\frac{x}{y}$.

**4.** If $x$ pounds is the weight of 5 coils of wire, express the weight of one coil of wire.

**5.** If $y$ pounds is the weight of $z$ coils of wire, express the weight of one coil of wire.

**6.** Express the weight of one coil of wire if $x$ coils weigh $y$ pounds.

**7.** If the discount is $x$ dollars on a hat, priced at $p$ dollars, express the rate of discount.

**8.** If the commission is $c$ dollars on a sale of $s$ dollars, express the rate of commission.

**9.** If the gain is $n$ dollars on an article that cost $c$ dollars, express the per cent of gain based on the cost of the article.

**10.** If a boy gains in weight $p$ pounds in $n$ months, express his average monthly gain.

### EXPRESSING VALUES IN OTHER FORMS

**1.** Suppose that you wish to express 6 feet as inches. To do this you multiply 6 by 12. How many inches are there in 9 feet?

**2.** How many inches are there in $x$ feet?

*Think:* $12 \times x = 12\,x$, the number of inches in $x$ feet.

Supply the missing items below:

**3.** $y$ ft. = — in.

**4.** $y$ yd. = — ft.

**5.** $y$ yd. = — in.

**6.** $x$ mi. = — rd.

**7.** $x$ qt. = — pt.

**8.** $z$ gal. = — qt.

**9.** $n$ hr. = — min.

**10.** $s$ min. = — sec.

**11.** $x$ dollars = — dimes

**12.** $d$ dollars = — nickels

**13.** $p$ lb. = — oz.

**14.** $t$ T. = — cwt.

**15.** $n$ yr. = — mo.

**16.** $c$ cu. yd. = — cu. ft.

**17.** $r$ sq. ft. = — sq. in.

**18.** $b$ acres = — sq. rd.

**19.** How many feet are there in $x$ inches?

*Think:* $x$ in. divided by 12 $= \frac{x}{12}$, the number of feet.

Supply the missing items below:

**20.** $y$ in. = — ft.

**21.** $y$ in. = — yd.

**22.** $x$ ft. = — yd.

**23.** $r$ rd. = — mi.

**24.** $p$ pt. = — qt.

**25.** $p$ pt. = — gal.

**26.** $r$ sec. = — min.

**27.** $d$ dimes = — dollars

**28.** $q$ oz. = — lb.

**29.** $x$ cwt. = — T.

**30.** $n$ mo. = — yr.

**31.** $y$ cu. in. = — cu. ft.

**32.** How many minutes are there in $x$ hours and $y$ minutes?

**33.** How many quarts are there in $b$ gallons $c$ pints?

### FINDING A MISSING DIMENSION

**1.** A rectangle has an area of 40 square inches. Its length is 8 inches. How much is its width?

Recall the formula: $A = lw$.

The area, 40, is the product of 8 and some number, representing the width.

$$8 \times ? \text{ number} = 40.$$

To find the missing number, divide 40 by 8.

The width is 5 inches.

A shorter way to write the work above is:

$$8w = 40$$

This expression is called an *equation*. To find the value of $w$, divide 40 by 8. This gives 5.

Find the missing numbers, represented by letters:

**2.** $4w = 40$ **4.** $2x = 18$ **6.** $9x = 18$ **8.** $12i = 36$

**3.** $6w = 36$ **5.** $7p = 21$ **7.** $3r = 21$ **9.** $4g = 16$

**10.** The length of a rectangle is 4 inches. Its area is 20 square inches. Find its width.

**11.** The width of a rectangle is 6 inches. Its area is 18 square inches. How much is its length?

**12.** The width of a rectangle is 4 feet. Its area is 14 square feet. Find its length.

Find the missing items for the rectangles given below:

| | Area | Length | Width |
|---|---|---|---|
| **13.** | ? | 12 in. | 10 in. |
| **14.** | 48 sq. in. | 8 in. | ? |
| **15.** | 64 sq. ft. | ? | 12 ft. |
| **16.** | 30 sq. yd. | ? | 6 yd. |
| **17.** | 10 acres | 100 rd. | ? |
| **18.** | 100 acres | ? | 160 rd. |

### SOLVING EQUATIONS

You have learned that a letter in a formula may represent a number. You have also learned that an expression like $3w = 12$ means "3 times what number equals 12." The work below will explain some other uses of letters.

**1.** John had some marbles. Henry has 20 more than John. If Henry has 50 marbles, how many has John?

Let $x$ represent the unknown number of marbles John has.
Then $x + 20$ represents the number of marbles Henry has.
Since Henry has 50 marbles, $x + 20 = 50$.
You know that $x$ must equal 30, because $30 + 20 = 50$.
To find the value of $x$, subtract 20 from 50. This gives 30.

The expression $x + 20 = 50$ is called an *equation* because it represents an equality of two expressions. In an equation a letter represents a certain number.

**2.** A certain number increased by 10 equals 15. If $x$ represents the number, show that $x + 10 = 15$ is a true equation. Find the value of $x$. When we find the value of a letter, we *solve* the equation.

Write equations for the following:

**3.** A number increased by 4 is 9.

**4.** $x$ increased by 5 is 16.

**5.** Principal ($p$) increased by \$40 is \$440.

Find the values of the letters in the following equations:

| | *a* | *b* | *c* |
|---|---|---|---|
| **6.** | $x + 2 = 5$ | $x + \frac{1}{4} = 2$ | $x + 9 = 27$ |
| **7.** | $x + 3 = 7$ | $n + 2\frac{1}{2} = 3$ | $p + 5\frac{1}{2} = 7\frac{1}{2}$ |
| **8.** | $x + 4 = 9$ | $x + 7\frac{1}{4} = 9$ | $x + 1\frac{1}{2} = 3$ |
| **9.** | $x + 15 = 24$ | $a + 5 = 17\frac{1}{2}$ | $4w = 16$ |

### WRITING AND SOLVING EQUATIONS

**1.** John says, "I am thinking of a number. If I subtract 3 from the number, the result is 5. What is the number?

The equation is:

$x - 3 = 5$. You can see that the number must be 3 more than 5. The number is 8, since $3 + 5 = 8$.

Check: Substitute 8 for $x$ in the equation $x - 3 = 5$. The work checks.

Find the value of the letter in each equation and check:

**2.** $x - 4 = 5$ **7.** $a - 4 = 15$ **12.** $m - 2\frac{1}{2} = 5$

**3.** $x - 2 = 7$ **8.** $b - 5 = 12$ **13.** $n - 5\frac{3}{4} = 6\frac{3}{4}$

**4.** $x - 6 = 9$ **9.** $c - 16 = 24$ **14.** $x + 5 = 9$

**5.** $x - 4 = 8$ **10.** $d - \frac{1}{2} = 2\frac{1}{2}$ **15.** $3r = 27$

**6.** $x - 3 = 16$ **11.** $x - \frac{3}{4} = 2\frac{1}{4}$ **16.** $n - 2 = 8$

Write equations for the following and solve them:

**17.** A number less 4 equals 7.

**18.** A number decreased by 5 equals 9.

**19.** Selling price ($s$) minus \$2.50 ($m$) equals \$10 (*cost*).

**20.** Amount ($a$) minus \$3.50 ($i$) equals \$160.50 ($p$).

**21.** Cost ($c$) minus \$18.00 ($s$) equals \$3.00 (*loss*).

**22.** Cost ($c$) plus \$3.00 (*margin*) equals \$16 ($s$).

**23.** Principal ($p$) plus \$16.00 ($i$) equals \$176 (*amount*).

**24.** Four times the side ($s$) of a square equals 48 inches.

**25.** Three times the side ($s$) of a triangle equals 36 feet.

**26.** The interest ($i$) for 2 years equals \$70.

**27.** The cost ($c$) of a hat less \$3.00 (*disc.*) equals \$6.

**28.** The selling price ($s$) less \$12.00 ($c$) equals \$188 ($n$).

**29.** The amount ($a$) less \$1,750 ($p$) equals \$187.50 ($i$).

### SOLVING EQUATIONS BY MULTIPLYING

**1.** A certain number divided by 4 gives a quotient of 8. Find the number.

*Think:* $\frac{x}{4} = 8$. You can see that the number must be 32, because $32 \div 4$ gives a quotient of 8. To find 32, multiply the 8 by 4.

*Check:* Substituting 32 for $x$, we find that $\frac{32}{4} = 8$. The work checks.

Find the values of the letters in the following and check.

**2.** $\frac{x}{4} = 6$

**3.** $\frac{x}{4} = 3$

**4.** $\frac{x}{4} = 9$

**5.** $\frac{a}{3} = 12$

**6.** $\frac{a}{5} = 9$

**7.** $\frac{b}{3} = 2$

**8.** $\frac{b}{4} = 8$

**9.** $\frac{x}{3} = 8$

**10.** $\frac{n}{4} = 12$

**11.** $\frac{n}{2} = 4$

**12.** $\frac{n}{4} = 1\frac{1}{2}$

**13.** $\frac{n}{3} = 2\frac{2}{3}$

**14.** $4x = 16$

**15.** $x + 4 = 12$

**16.** $x - 3 = 4$

**17.** Half of a certain number ($n$) equals 4. Write the equation and solve it.

**18.** One fourth of John's age is 12. Write an equation and find John's age.

**19.** A discount of $\frac{1}{4}$ of the price ($p$) of a ball was equal to \$.25. Find the price of the ball.

*Think:* $\frac{p}{4} = \$.25$. Find $p$.

**20.** A discount of $\frac{1}{3}$ of the price of a suit of clothes was equal to \$7.50. Find the price of the suit of clothes.

## PRACTICE IN SOLVING EQUATIONS

Solve these equations one set at a time. Check.

### Set I

| | *a* | *b* | *c* |
|---|---|---|---|
| 1. | $4x = 12$ | $3x = 9$ | $5x = 10$ |
| 2. | $x + 5 = 7$ | $x + 4 = 6$ | $x + 2 = 8$ |
| 3. | $x - 3 = 4$ | $a - 3 = 5$ | $y - 7 = 2$ |
| 4. | $\frac{x}{4} = 8$ | $\frac{x}{3} = 2$ | $\frac{a}{5} = 3$ |

### Set II

| | | | |
|---|---|---|---|
| 1. | $5x = 20$ | $2a = 16$ | $3n = 21$ |
| 2. | $a + 5 = 15$ | $n + 3 = 16$ | $y + \frac{1}{2} = 4\frac{1}{2}$ |
| 3. | $x - 3 = 5$ | $p - 4 = 7$ | $m - 3\frac{1}{2} = 5$ |
| 4. | $\frac{a}{2} = 5$ | $x - 5 = 8\frac{1}{2}$ | $\frac{x}{5} = 2\frac{1}{2}$ |

### Set III

| | | | |
|---|---|---|---|
| 1. | $x + 3 = 7$ | $a - 5 = 7$ | $3x = 15$ |
| 2. | $7x = 35$ | $\frac{a}{3} = 5$ | $x + 8 = 21$ |
| 3. | $n - 5 = 7$ | $x + 5 = 19$ | $4n = 10$ |
| 4. | $y - 2.2 = 4.8$ | $x + 3.5 = 7.5$ | $\frac{x}{5} = 2.5$ |

## USING FORMULAS

Write problems solved by the following formulas. Then solve the problems.

1. $A = lw$ 3. $V = lwh$ 5. $C = 2\pi r$ 7. $P = 4s$
2. $A = \frac{1}{2}ba$ 4. $A = \pi r^2$ 6. $A = ab$ 8. $P = 2l + 2w$

## PRACTICE TESTS IN THE FUNDAMENTALS

You should be able to find the answers for each of the following sets of examples in the time allowed. Always check your work. Copy the examples when necessary before counting time.

### ADDITION (6 minutes)

| 1. | 2. | 3. | 4. | 5. | 6. |
|---|---|---|---|---|---|
| 684 | 235 | 693 | 849 | 331 | 996 |
| 336 | 250 | 164 | 607 | 349 | 811 |
| 956 | 792 | 845 | 942 | 285 | 982 |
| 742 | 877 | 452 | 358 | 466 | 513 |
| 493 | 978 | 749 | 516 | 588 | 241 |
| 536 | 769 | 789 | 799 | 417 | 918 |

### SUBTRACTION (4 minutes)

| 1. | 2. | 3. | 4. |
|---|---|---|---|
| 9,317 | 9,361 | 7,493 | 8,802 |
| 4,432 | 4,327 | 2,638 | 1,326 |
| **5.** | **6.** | **7.** | **8.** |
| 8,921 | 9,727 | 9,322 | 8,362 |
| 5,896 | 2,039 | 3,345 | 1,799 |
| **9.** | **10.** | **11.** | **12.** |
| 8,431 | 5,244 | 8,510 | 7,456 |
| 4,988 | 2,579 | 5,889 | 4,679 |

### MULTIPLICATION (8 minutes)

| 1. | 2. | 3. | 4. | 5. | 6. |
|---|---|---|---|---|---|
| 395 | 269 | 179 | 735 | 417 | 281 |
| 74 | 28 | 93 | 56 | 704 | 65 |
| **7.** | **8.** | **9.** | **10.** | **11.** | **12.** |
| 147 | 268 | 268 | 853 | 946 | 534 |
| 82 | 39 | 47 | 208 | 506 | 309 |

**DIVISION (8 minutes)**

**1.** $46\overline{)16{,}422}$ **2.** $85\overline{)27{,}115}$ **3.** $39\overline{)28{,}509}$ **4.** $64\overline{)60{,}224}$

**5.** $27\overline{)10{,}395}$ **6.** $58\overline{)15{,}892}$ **7.** $98\overline{)49{,}784}$ **8.** $85\overline{)81{,}260}$

Use these examples for special practice from time to time.

## PRACTICE TEST IN FRACTIONS—NUMBER IX

Practise this exercise until you can work all of the examples correctly in *less than five minutes*. Compare your score with those for preceding tests.

**1.** $9\frac{2}{3} + \frac{5}{9} =$
**2.** $12\frac{3}{4} - \frac{7}{8} =$
**3.** $3\frac{4}{5} \times 4\frac{1}{2} =$
**4.** $8 + 3\frac{2}{5} =$
**5.** $7 + 6\frac{3}{4} =$
**6.** $8\frac{3}{4} \div 2\frac{1}{5} =$
**7.** $5\frac{7}{8} \div 6 =$
**8.** $28 - 6\frac{2}{3} =$
**9.** $11\frac{1}{3} - 6\frac{1}{2} =$
**10.** $\frac{3}{4} \times 3\frac{1}{2} =$
**11.** $\frac{3}{5} \div 2\frac{1}{2} =$
**12.** $7\frac{1}{2} \times 9\frac{1}{3} =$

## PRACTICE TEST IN DECIMALS—NUMBER VIII

Practise this exercise until you can work all of the examples correctly in *less than five minutes*. Compare your score with those for preceding tests. Keep a record of your scores in your notebook.

**1.** $9.5 + 4.7 + 8.6 =$
**2.** $4.21 + 7.6 + 49.37 =$
**3.** $.6 + 5.94 + 12.1 =$
**4.** $87.5 - 14.8 =$
**5.** $64.28 - 5.3 =$
**6.** $7.9 - 1.625 =$
**7.** $16 \times .53 =$
**8.** $8 \times 1.25 =$
**9.** $.03 \times 59.7 =$
**10.** $8.64 \div .9 =$
**11.** $3.75 \div .25 =$
**12.** $98.2 \div .12 =$
**13.** Change $8\frac{4}{5}$ to a decimal.
**14.** Change $.87\frac{1}{2}$ to a common fraction.

### PRACTICE TEST IN PERCENTAGE—NUMBER VI

You should be able to work all of the examples correctly in *less than five minutes.*

1. Express as per cents: $\frac{1}{6}$, .5, 4, $1.6\frac{1}{4}$, .004, 1.35.
2. Express as decimals: 2%, 3.5%, 125%, 38%, $\frac{1}{2}$%, 50%.
3. 25% of \$400 =
4. 18 = ?% of 40.
5. 8% of ? = 5,280.
6. 48 = 15% of ?
7. $7\frac{1}{2}$% of 640 =
8. 75 = ?% of 180.
9. Find 120% of 480.
10. What per cent of 500 is 750?

### PRACTICE WITH FORMULAS

Explain the following formulas in words and be ready to give a problem that may be solved by each.

1. $P = 2l + 2w$
2. $d = 2r$
3. $V = lwh$
4. $A = \frac{1}{2}a(b + c)$
5. $A = lw$
6. $P = a + b + c$
7. $A = s^2$
8. $C = \pi d$
9. $I = prt$
10. $A = \frac{1}{2}ab$
11. $A = \pi r^2$
12. $P = 4s$

### FINDING MISSING NUMBERS

1. Find the missing numbers in the following rectangles:

| | Length | Width | Area |
|---|---|---|---|
| *a.* | 40 ft. | 16 ft. | ? |
| *b.* | ? | 24 in. | 144 sq. in. |
| *c.* | 80 rd. | ? | 2 acres |

2. Find the missing numbers in the following rectangular solids:

| | Length | Width | Depth | Volume |
|---|---|---|---|---|
| *a.* | 4 in. | $4\frac{1}{2}$ in. | $3\frac{1}{3}$ in. | ? |
| *b.* | 3 ft. | 2 ft. | ? | 60 cu. ft. |
| *c.* | ? | 3 yd. | $4\frac{1}{2}$ yd. | 81 cu. yd. |

### CUMULATIVE TEST VII

This test contains many different kinds of examples. If you make any mistakes on the test, practise other examples similar to those that you worked incorrectly. You should be able to complete all of these examples in *fifteen minutes.*

**1.** $27 - 16\frac{5}{3} =$ (*20*)
**2.** $32 \times 13\frac{1}{8} =$ (*10*)
**3.** $8 \div 12 =$ (*12*)
**4.** $\frac{3}{4} \div \frac{6}{7} =$ (*29*)
**5.** $.8 + .5 + .7 =$ (*39*)
**6.** $\frac{3}{4}$ of ? $= 72$ (*28*)
**7.** $42.15 - 27.87 =$ (*39*)
**8.** $100 \times .027 =$ (*45*)
**9.** $.07 \times .6 =$ (*41*)
**10.** $.945 \div 3.5 =$ (*48*)
**11.** 8% of \$3.25 = (*82*)
**12.** 4.2 = ? % of 16.8 (*90*)
**13.** 12 = 8% of ? (*93*)
**14.** $3\frac{3}{4} + 6\frac{1}{2} + 2\frac{7}{8} =$ (*20*)
**15.** .25% = ? decimal (*79*)
**16.** $4.7 + 319 + .189 =$ (*39*)
**17.** Change $1\frac{9}{1000}$ to a decimal. (*37*)
**18.** 1,082 ÷ 37 = ? (carry to 2 places). (*48*)
**19.** What per cent of 96 is 120? (*90*)
**20.** $\frac{1}{8}$ T. = ? lb.; $\frac{1}{4}$ gal. = ? pt. (*225*)
**21.** Divide 15,548 by 46. (*12*)
**22.** Find the product of 397 and 806. (*10*)
**23.** Subtract 17,698 from 24,273. (*8*)
**24.** Add 347, 279, 627, 579, 1,023, and 3,767. (*6*)
**25.** Compare $3\frac{3}{4}$ and $11\frac{1}{4}$ by division. (*94*)

### VOCABULARY EXERCISE

Give problems in which you are required to find the following:

| | | |
|---|---|---|
| area | net proceeds | rate of discount |
| volume | loss | circumference |
| interest | rate of interest | net profit |
| commission | rate of commission | net price |
| amount | discount | balance |
| perimeter | gain | sale price |

### PROBLEM SCALE V

**1.** At 3 for 8 cents, how much do 15 apples cost?

**2.** Harry bought a $40 bicycle at a "25%-off" sale. How much did he pay for the bicycle?

**3.** What was the gross profit on 48 boxes of oranges, bought at $2.75 a box and sold at $3.50 a box?

**4.** How many miles of road, costing $2,200 a mile, can be built for the price of 2 battleships costing $22,000,000 each?

**5.** Jack tested some seed corn in his tester. Of the 60 seeds he tested, all but 6 sprouted. What per cent did not sprout?

**6.** How many feet of wire are needed to inclose a garden 32 feet square if three rows of wire are strung, no allowance being made for openings?

**7.** In a recent year the average yield of wheat an acre was 14.5 bushels. Find the value of the yield of a 500-acre field at $1.32 a bushel.

**8.** What is the simple interest on $7,200 for $3\frac{1}{3}$ years at $6\frac{1}{2}\%$?

**9.** A wholesale dressmaking establishment bought 465 rolls of cloth, each containing 75 yards. How many dresses can be made from this cloth, allowing $3\frac{3}{4}$ yards for each dress?

**10.** A commission merchant sold 475 pounds of butter at 48 cents a pound and 480 bushels of potatoes at $1.09 a bushel. He received $2\frac{1}{2}\%$ of the total sales for his services. How much did he remit to the farmer?

# TABLES OF MEASURES

For Reference

### Counting

12 things = 1 dozen
12 dozen = 1 gross
20 things = 1 score

### Capacity

*Liquid Measure*

4 gills = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
231 cubic inches = 1 wine gallon
277.274 cu. in. = 1 imperial gallon

*Dry Measure*

2 pints = 1 quart
4 quarts = 1 gallon
2 gallons = 1 peck
4 pecks = 1 bushel
2,218.192 cubic inches = 1 bushel

### Weight

*Avoirdupois Weight*

16 ounces = 1 pound
100 pounds = 1 hundredweight (cwt.)
2,000 pounds or 20 hundredweight = 1 ton
2,240 pounds = 1 long ton
1 pound = 7,000 grains (troy)
196 pounds = 1 barrel of flour
62.5 pounds = 1 cubic foot of water
60 pounds = 1 bushel of wheat or potatoes
56 pounds = 1 bushel of corn or rye

*Troy Weight*

For jewels and precious metals
24 grains = 1 pennyweight (pwt.)
20 pennyweights = 1 ounce
12 ounces = 1 pound
5,760 grains = 1 pound (troy)
7,000 grains = 1 pound (avoirdupois)

### Length

12 inches = 1 foot
3 feet = 1 yard
16½ feet, or 5½ yards = 1 rod (pole or perch)
5,280 feet
1,760 yards
320 rods
} = 1 mile

4 inches = 1 hand
6 feet = 1 fathom
1.151 common miles = 1 knot
360 degrees = 1 circle

### Surface or Square Measure

144 square inches = 1 square foot
9 square feet = 1 square yard
30¼ square yards = 1 square rod
160 square rods or 43,560 square feet = 1 acre
640 acres = 1 square mile, or 1 section
36 sections = 1 township

### Solid or Cubic Measure

1,728 cubic inches = 1 cubic foot
27 cubic feet = 1 cubic yard

*Wood measure*

16 cubic feet = 1 cord foot
128 cubic feet, or
8 cord feet = 1 cord
24¾ cubic feet = 1 perch of stone

### Time Measure

60 seconds = 1 minute
60 minutes = 1 hour
24 hours = 1 day
7 days = 1 week
365 days = 1 year
366 days = 1 leap year

### Metric System (Equivalents)

10 millimeters = 1 centimeter
100 centimeters = 1 meter
1,000 meters = 1 kilometer

1 inch = 2.54 centimeters
1 foot = 30.48 centimeters
1 yard = 0.9144 meter
1 mile = 1.6093 kilometers

### Equivalents

6¼ gallons = 1 cubic foot
1 bushel oats = 34 pounds
¼ peck potatoes = 3 pounds 12 ounces
1 gal. water at any temperature weighs approximately 10 lb.
1 ton coal = 35 cubic feet (approximately)
£ Sterling = $4.86\frac{2}{3}$

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QA 39 B21 BK-1
BANTING LILIAN
MATHEMATICS FOR EVERYDAY USE

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